

2 Enlisted strength in the '80s: a mid-term reassessment

*James R. Hosek, Richard L. Fernandez,
and David W. Grissmer*

Do the economic recovery and declining numbers of enlistment-age youth signal trouble ahead for the All Volunteer Force? Not necessarily, according to Rand Corporation researchers. Their findings indicate that traditional forecasts of enlisted force strength focus too exclusively on supply, failing to take into account the effect of retention rates on the demand for high-quality enlistees. As reported in this article, Rand projections for the remainder of the decade are more optimistic, though they do raise serious policy issues.

10 A total-force approach to manpower planning

Deborah Clay-Mendez

Recent initiatives to increase the strength of the reserve components underscore the need for fully integrated manpower planning if DoD is to achieve a cost-effective mix of active and reserve forces. In this article, the author presents findings from a cost-benefit analysis of alternative accession policies for the Naval Selected Reserve. Using a methodology that should be of interest to all DoD manpower planners, the study represents one of the first formal attempts to analyze military accession policies from a total-force perspective.

18 Progress in productivity, the cornerstone of excellence

Lawrence J. Korb

For several years the Defense Department has strongly emphasized the importance of enhancing defense productivity. Efficiency reviews, capital investments, quality circles, and suggestion and recognition awards are some of the programs DoD has used in its effort to improve defense readiness. Here the author regales us with a multitude of success stories, demonstrating conclusively that productivity is a cornerstone well set and capable of providing support for years to come. Also offered is a glimpse of productivity initiatives in the offing.

22 DoD's quality-excellence initiatives: from spares reform to streamlining

William H. Taft IV

In remarks before the House Armed Services' Subcommittee on Procurement and Military Nuclear Systems on April 4, 1985, the deputy secretary of defense reviewed a number of the initiatives being undertaken by the Defense Department to improve the efficiency of its acquisition management. Discussed during his testimony were DoD's streamlining initiative, the newly formed test and evaluation office, warranties, competition, spare-parts procurement reform, and an aggressive audit program designed to weed out waste, fraud, and abuse.

The *Defense Management Journal* is a quarterly publication of the Office of the Assistant Secretary of Defense (Manpower, Installations and Logistics). As a forum for the interchange of ideas, the *DMJ* publishes articles on current defense policies and on methods for improving defense management. Unless otherwise stated, the views herein are those of the

of its elements.

To subscribe, Army and Air Force personnel should forward DA Form 12-4 and Air Force Form 764, respectively, through normal publications requisitioning channels. Navy and Marine Corps personnel should submit requests to Headquarters, Naval Material Command, MAT OOD, Crystal

26 Industry looks at the U.S.'s ability to surge

Roderick L. Vawter

The ability to respond quickly can be decisive in a national emergency. Critical to such a response is a defense production base that is ready to surge. Is U.S. industry in that state of readiness now? What can we do to strengthen the nation's ability to expand defense production quickly? In 1983, at the request of the under secretary of defense for policy, a group of defense contractors carried out a simulation exercise to help answer those questions. In this article the author reports on the findings.

36 Serial number tracking is more than a numbers game

Roland E. Berg

Breakthroughs in automated data processing technology herald a new era for serial number tracking, a maintenance aid in use now for nearly three decades. Recent developments have improved both the accuracy and timeliness of this data-gathering process and reduced its cost as well. As a result, the services have already realized substantial gains in readiness and savings and are developing additional applications. In this article, the author describes four successful tracking programs that illustrate the benefits available.

42 The promise and peril of overseas maintenance

Lieutenant Colonel Justin M. Martin, USMC

The extent to which the Defense Department should rely on overseas depot maintenance continues to stir debate. The concept has potentially far-reaching diplomatic, economic, and force-readiness ramifications about which experts often disagree. In this article, the author presents the positions of both advocates and opponents, and highlights the difficulties involved in formulating an overseas maintenance policy. He also notes the need for additional data if the nation is to adopt a policy that is fiscally sound and militarily prudent.

48 Departments

Federal personnel manager: *DMJ* legal columnist Stephen A. Klatsky reviews the evolution of sexual-harassment case law. **Report synopsis:** Georgetown University's Center for Strategic and International Studies examines ways to improve the organization and management of the U.S. defense establishment and concludes that selected facets of military planning, resource allocation, and program management are ripe for reform. **News summary:** ADPA sponsors a new maintenance award, DoD seeks to increase the lure of its survivor plan, and more.

their administrative officers. Nonfederal employees and organizations may subscribe through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Address all correspondence to: Editor, *Defense Management Journal*, OASD (MI&L), Cameron Station, Alexandria, VA 22304-6182. You can call *DMJ* at (202) 274-5757 or AUTOVON 284-5757.

Secretary of Defense: Caspar W. Weinberger
Assistant Secretary (MI&L): Lawrence J. Korb
Editor: Larry J. Wilson
Senior Editor: David R. Lampe
Associate Editor: Thomas J. Gelfi
Editorial Assistant: Rose Fletcher

ALIST

ing to fill this
eers of data
of manage-
ssurance prin-

firm involved in
tems, and CSS
. These positions

ve to:

SOLUTIONS
Court
d 20877
nel Administrator

ISOR UTER TORS

y recognized financial ser-
vicing to enjoy a rapid rate of
and additional utilization of
is causing the expansion of
operation.

responsible for computer opera-
tioning schedules, failure diagnosis,
computer facility status. Will also
and control personnel, establish
operation for maximum effi-
ciency. 5 years operating

process. We sta-
enced the development pro-
quality product. Our current contracts require
Assurance systems for some of the most complex systems
ever undertaken.

If you are looking for challenge, growth and some of the most interesting work
available in our business, send us your resume. Or better yet, stop by our offices
and drop it off. We'll give our brochure in return. We require U.S. citizenship and
are an equal opportunity employer.

BTG, Inc.

1945 Old Gallows Road, Suite 710
Vienna, Virginia 22180
(703) 556-6518

ENGINEER

ENGINEERS

Quest Research Corporation, a fast growing, high-technology company, is cur-
rently seeking creative individuals who desire exciting technical challenges and
career advancement.

- **Communication Systems Engineers** — Will establish require-
ments for intercept receivers and jammers for military applications via com-
puter modeling and specific experimental design.
- **RF Engineers** — Design, test, and evaluation of VHF/UHF antenna
systems.
- **Systems Engineers** — Analysis, design and integration of complex
state-of-the-art computer-based equipment systems.



I WANT YOU

RGI is pr-
government on-line d-
ADP support includes system design
testing and implementation.

We have multiple positions immediately available. If you
have experience in any of the following areas:

- Software change control
- Program Testing (V&V)
- Pay/Personnel Systems requirements definition
- Data base administration
- Structured analysis
- COBOL coding
- Production control
- Navy or HP3000 background a plus
- U.S. citizenship required for all positions

Send resume to Buck Simpson:

RGI, INCORPORATED

Skyline II, Suite 1300
5203 Leesburg Pike
Falls Church, Va. 22041

E.O.E. M/F

COMPUTERS

The ORKAND CORPORATION is an established and
rapidly growing management consulting and comput-
erized information systems company. In achieving our
high growth, we have earned a reputation for top
quality work on projects that make a difference to our
broad base of clients. To continue our growth, while
maintaining the quality of our work, we seek highly
motivated individuals with the intellect, energy and
commitment necessary for achievement in a prof-
essionally challenging competitive environment.

SYSTEMS ANALYSTS

2-3 years computer system analysis exper-
ience in large scale survey design, programming and oper-
ation of information processing systems. Must have
experience in the use of structured design techniques,
database concepts. Exposure to SAS, COBOL,
JCL, ADABAS and TPL a plus.

PROGRAMMERS

1-3 years hands-on experience with COBOL,
JCL, SAS or INQUIRE in an IBM environment.
If you meet the above requirements, have a
degree and want to be a part of a suc-
cessful firm, please send resumes to: Re-
sponse, 8484 Georgia Av., Suite 800, Silver
Spring, MD 20910.

THE ORKAND CORP

Equal Opportunity Employer, M/F

Computers

TRAINER

Hadron, Inc., has a long term co-
ntract with the state of Virginia for a
state-of-the-art data processing
and training professional.

VM/CICS sh-
The PROGRA
application
specification
equivalent
Please for
Anne Her-

DYN

COMPUT

We r-
base
200
sel
da
RB
e

Enlisted strength in the '80s: a mid-term reassessment

By JAMES R. HOSEK,
RICHARD L. FERNANDEZ,
AND
DAVID W. GRISSMER

Demographic trends can be a misleading indicator of future enlisted force strength; other key variables affect quality and numbers too.

Six years ago, the All Volunteer Force appeared to be in serious trouble, and many observers believed that a return to peacetime conscription would be inevitable by the mid-1980s. This belief was fueled by recruitment shortfalls, declining retention rates, unfavorable supply projections, and the services' growing need for skilled personnel. The actual experience of recent years has not confirmed this pessimistic view. On the contrary, the services have met accession requirements fairly easily, retention rates have risen to new highs, and the proportion of high-quality enlistees has surpassed projections.

Despite these successes, many people question the services' ability to meet enlisted strength and quality goals. They believe that a return to conscription has merely been delayed by unusually high unemployment rates, large pay raises in the early 1980s, and increased use of enlistment benefits and reenlistment bonuses. This view holds that military compensation would have to reach unprecedented—and politically infeasible—levels to sustain the volunteer force in the face of economic recovery and the decline in the enlistment-age population. This article proposes a more optimistic interpretation.¹

The Rand studies that inform the following discussion differ from traditional studies in several significant ways, and we have developed a model, based on our findings, that reflects those differences. In essence, this model addresses the interrelationships of policy variables such as military wages, bonuses, and recruiting, external variables such as civilian wages, the unemployment rate, and the youth population; and forecasts of high-quality enlistment, retention rates, and the structure of the enlisted force. Most force assessments focus on enlistment supply and measure the success of the All Volunteer Force by its ability to attract high-quality enlistees. Rand's model assesses enlistment demand and looks at retention trends within the entire enlisted force. Placing the larger context makes the decline in enlistment and retention and the potential decline in high-quality accession less alarming. In addition, it reveals problems and policy alternatives that need immediate attention.

Forces affecting supply in the 1980s

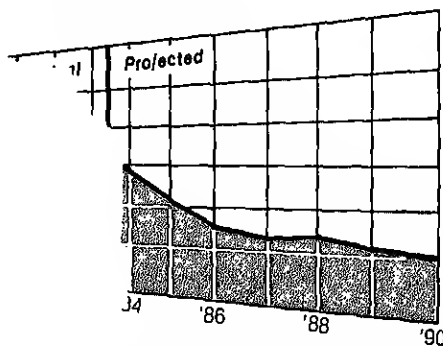
Figure 1 (p. 4) shows three key variables that will influence enlistment supply in the 1980s: the youth population, the unemployment rate and the military wage ratio. In addition, recent Rand work estimates that

¹For a fuller discussion of many of these points, see James R. Hosek, Richard L. Fernandez, and David W. Grissmer, "The All Volunteer Force: A Mid-Term Reassessment," RAND Report R-2800-1, RAND Corporation, Santa Monica, CA, 1982.

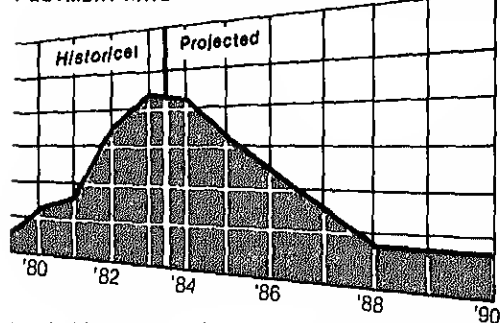
Variables influencing the enlistment supply

s are predicated on trends in population, yment, and civilian wages. Equally important, is the ratio of military-to-civilian pay.

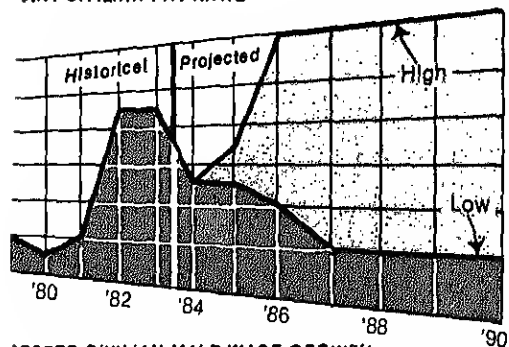
YOUTH POPULATION, AGE 17-21



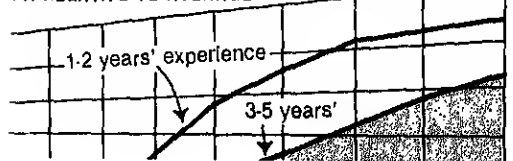
EMPLOYMENT RATE



MILITARY-CIVILIAN PAY RATIO



PROJECTED CIVILIAN MALE WAGE GROWTH: TH RELATIVE TO AVERAGE*



During the 1970s, the number of 17- to 21-year-old males rose steadily, reaching a peak in 1979 (Figure 1A). Since then, the trend has reversed, and the Census Bureau projects 12 percent fewer of them in 1990 than there were in 1983.² That trend alone should result in a decline in enlistments, and that decline would be aggravated by falling unemployment rates. As Figure 1B shows, unemployment during recent years was at its lowest in 1979, and the services experienced their most serious recruitment shortfalls in that year as well. If the current economic recovery follows the path projected by the Congressional Budget Office, we can expect the declining unemployment rates that the figure shows. So far, the recovery has proceeded more rapidly than forecast, and the concomitant employment gains may make enlistment and retention goals harder to achieve.

They will be even harder to achieve if Congress does not maintain a reasonably high military-civilian pay ratio. Figure 1C shows that this ratio reached a low point in 1979; along with low unemployment, it seems to have contributed to the force's recruitment problems during that year. By contrast, 1982 was a banner recruitment year, and it was also the year of highest unemployment and the highest military-civilian pay ratio. But as the economy has begun its recovery, that ratio has started to slip. If it is allowed to slip further, accessions and retentions can also be expected to decline, given historical experience.

Figure 1C depicts the plausible range of the pay ratio for the projected years. The bottom line depicts a scenario in which military pay raises lag behind those in civilian pay until FY 87, then keep pace until FY 90. This path would return the pay ratio to the low level of 1979. The top line depicts a scenario in which military pay raises at first exceed the average change in civilian pay in order to make up ground lost since FY 83, then match civilian pay growth from FY 86 to FY 90. Recent pay raises and those anticipated in FY 86 more nearly match the low-pay than the high-pay scenario.

Simply adjusting military pay to maintain parity with average civilian wages may not ensure parity at the enlistment point. Recent Rand estimates of the effect of cohort size on wages indicate that as the proportion of 17- to 21-year-olds declines, their wages will tend to increase relative to the average wage.³ Figure 1D shows that by 1990,

²The break between historical and projection periods reflects the date when most of the data and projections presented here were last updated. In general, the projections have tracked recent experience fairly well, despite the faster-than-expected decline in young enrollment. Because of service recruiting efforts, the

wages of male high school graduates with one or two years of work experience will have risen about 4 percent faster than average civilian wages, and pay for those with three-to-five years' experience will have risen about 3 percent faster.

Taken together, the trends in youth population, unemployment, and the civilian wage structure would seem to support those who argue that the enlisted force's shining years have passed and that trouble lies ahead. But changes in the military-civilian wage ratio will either aggravate or mitigate the effects of these other trends. Consequently, forecasts about enlistment, retention, and force structure must take into account the wage ratio changes.

Our forecasts extend traditional assessment methods by tracing the effects that future rates of enlistment and retention will have on the entire enlisted force structure through 1990. This new analysis indicates that, despite the declining youth population and recovering economy, recruiting may not become the pressing concern it was in the 1970s.

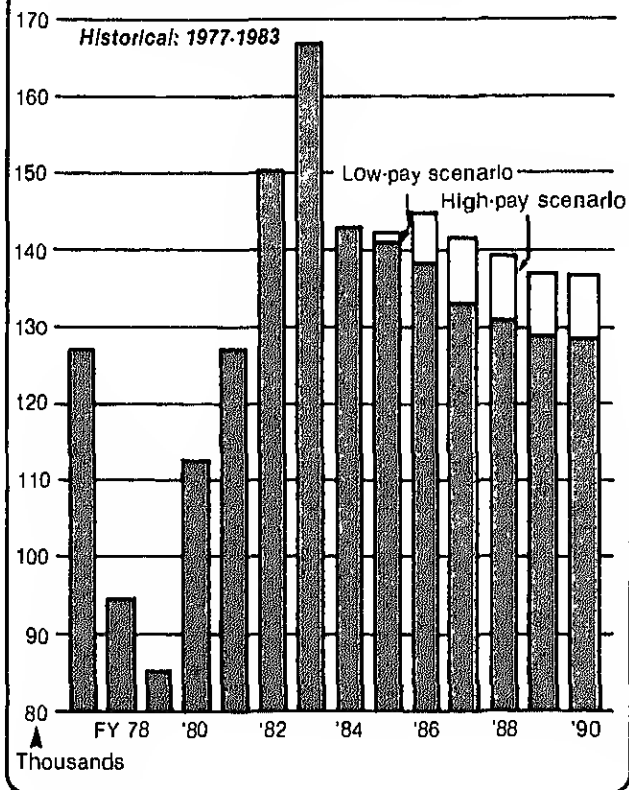
Forecasting high-quality enlistments

Figure 2 shows projected levels of high-quality⁴ male enlistments for high- and low-pay scenarios as well as actual levels since 1977.⁵ Under both scenarios, the number of high-quality recruits will drop somewhat from recent highs, with most of the decline occurring during the upswing in the national economy in FY 84 and FY 85. By FY 90 we expect a 17 percent decline under the high-pay scenario and a 22 percent decline under the low-pay scenario, relative to the peak in FY 83. Given high pay ratios, the number of high-quality male enlistments is likely to remain above the levels of the late 1970s. If pay is low, they probably will return to or drop somewhat below the 1977 level. The projected drop under both scenarios largely reflects an anticipated decrease in unemployment and the expected tilting of the wage structure in favor of younger men.

The model that produced these projections attributes a smaller portion of the decline to the diminishing youth population than do most other models. The latter generally assume that a one percent decline in the youth population would, other things being equal, cause a one percent de-

Figure 2. Forecast of high-quality male enlistments

Under both high- and low-pay assumptions, Rand researchers predict a decline in high-quality recruits relative to the peak of FY 83.



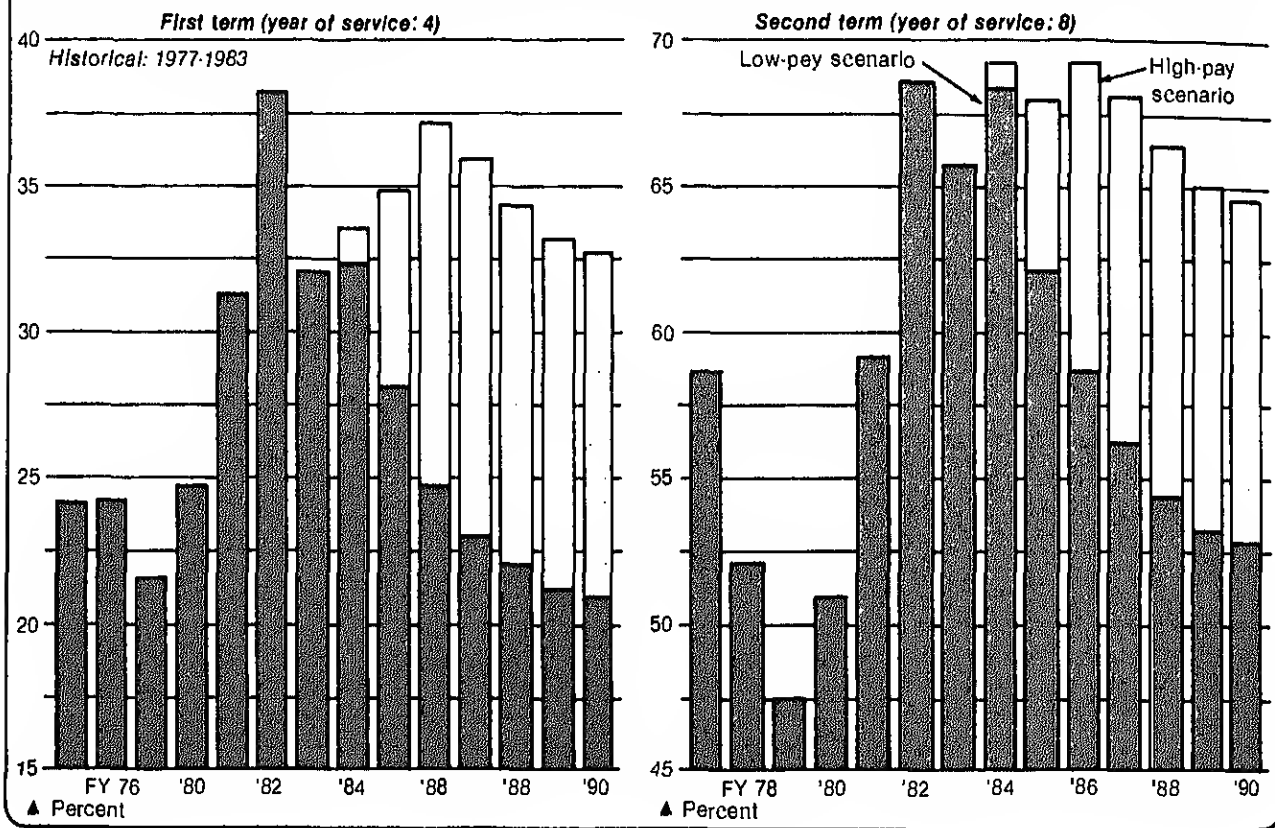
cline in high-quality enlistments. That view implies that recruiters have completely saturated the market; but even the Army, which has the largest number of field recruiters, has only one for every 300 male high school seniors. Consequently, increased recruitment efforts could keep high-quality enlistments from succumbing proportionately to population declines.

Nevertheless, even a high-pay scenario is not likely to maintain the current high-quality enlistment levels in the face of strongly improving national employment conditions. To offset the forecast downturn, Congress would evidently either have to raise military pay at least several percentage points above the high-pay scenario, or vastly increase recruiting resources, or do both. Since Congress does not seem inclined to take such action, the question becomes: will projected supplies be adequate to meet the services' need for high-quality recruits? In answering this question, one must consider the projected decline in the

³Hong Tan and Michael P. Ward, *Forecasting the Wages of Young Men*, R-3115-ARMY, Rand Corporation (forthcoming).

⁴High school graduates who score in the upper half on the Armed Forces Qualifying Test.

this decade depends on the pay ratio. Regardless, Rand analyses indicate that retention rates will remain strong enough to produce a more senior enlisted force and thus reduce demand for accessions.



equal attention.

To meet end-strength requirements, the services seek to control the flow of accessions and losses throughout the year. Low retention rates create a shortage of trained, experienced personnel, consequently upping demand for new enlistments. Conversely, high retention rates reduce that demand. The size of the enlisted population approaching reenlistment also matters. If the population is large, the numbers of retained personnel may increase even though retention rates decline. If the services retain high numbers of personnel in the future, the expected decline in enlistments, including high-quality accessions, will not prove as serious as expected.

To forecast first- and second-term retention behavior, we used models that relate retention rates to variables such as the pay ratio, the unemployment rate, reenlistment bonuses, and certain demographic factors.⁶ We then fed

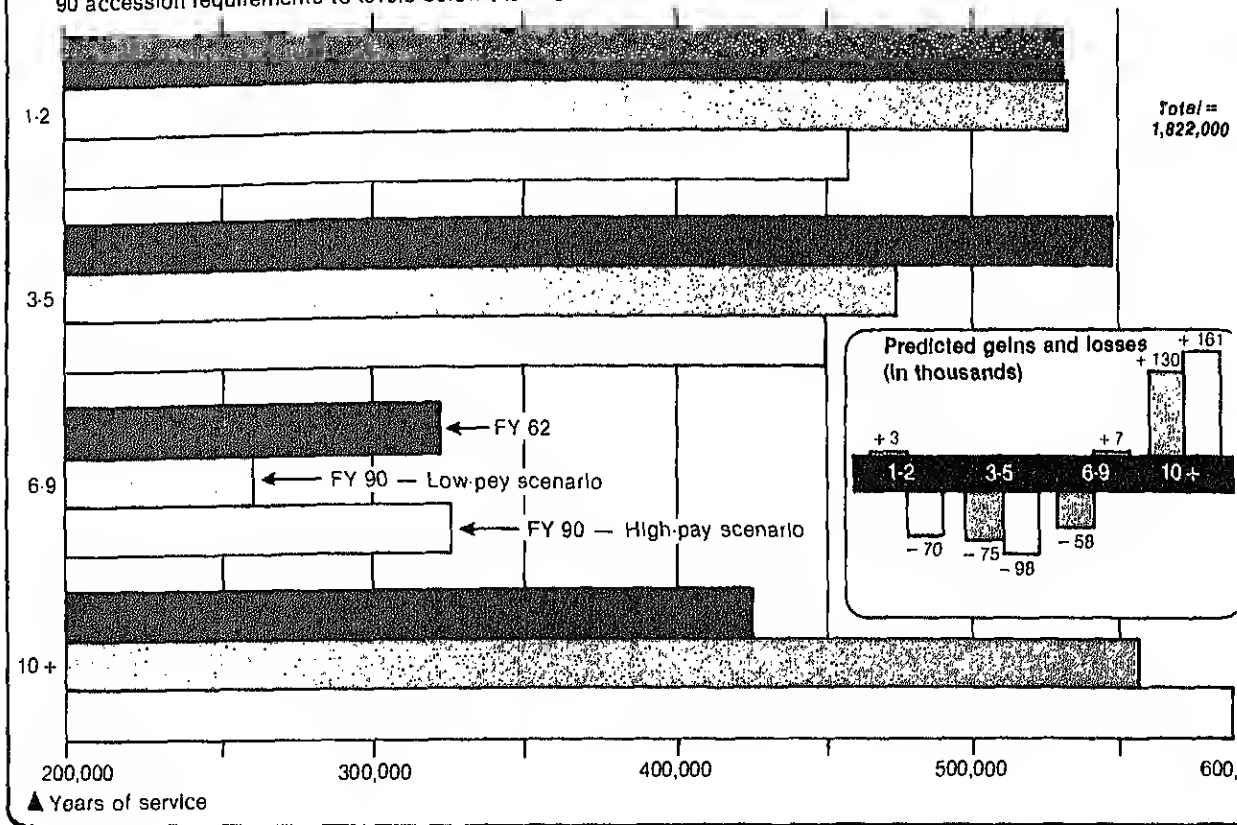
those retention rates into the model used to project the enlisted force structure. All retention rates fell from FY 77 to FY 79 but improved considerably thereafter. Figure 3 shows actual and potential retention rates for one subgroup—white male high school graduates—nearing the end of the first and second terms of service. For this group, first-term retention increased from 22 percent in 1979 to a remarkable 38 percent in 1982. In the same period, the second-term retention rate went from 47 percent to 68 percent.

Retention will remain strong

Where will these rates go in the forecast period, 1984 to 1990? That depends on the pay ratio. If the economy improves as projected and pay ratios decline, the first-term rate will probably drop from about 32 percent to 21 percent. By contrast, a high pay ratio should sustain the robust level of 1983. The picture for second-term retention is much the same. For both reasons, we project high pay ra-

⁶See James R. Hosek and Christine E. Peterson, *Selective Reenlistment Bonuses and Retention Behavior*, R-3100 MIT, Rand Corp., 1983.

Assuming an end-strength requirement of 1.8 million, the population of enlisted personnel with 10 or more years of service will increase by at least 35 percent, reducing 90 accession requirements to levels below those of the late 1970s.



to current rates, while low pay ratios are likely to produce retention rates so low that they raise serious concern about maintaining force strength in the mid-career years. But in either case, our analyses indicate that retention rates will remain strong enough to produce a more senior enlisted force and thus to reduce demand for accessions.

Our force-structure projections assume that the enlisted force will continue to have an end-strength requirement of about 1.8 million and that the services will adjust annual accessions to meet that requirement.⁷ Given those conditions, our projections show that between FY 82 and FY 90 the population of enlisted personnel with ten or more years of service will increase by 31 percent (130,000 persons) under the low-pay scenario and 39 percent (161,000 persons) under the high-pay scenario (see Figure 4). As the figures for first- through fifth-year personnel suggest, this dramatic increase in senior career forces will reduce FY 90

accession requirements to levels well below those of the late 1970s, especially under the high-pay scenario. If a rate, these projections indicate that the enlisted force have no trouble sustaining the 1983 end-strength through 1990.

Why do our findings differ so markedly—optimistically—from those of other studies? Pessimistic assessments have focused on accession supply, as affected by the declining youth population and the improving economy. They have overlooked the unprecedented increase in retention and its effect on accession demand. However, the services have been making this trade-off between large flows of junior personnel and greater stock of experienced personnel for a number of years.

Several factors have contributed to increased retention: the change to a volunteer force; recent rises in military pay, unemployment, and reenlistment bonuses; and higher accession levels in the mid- and late-1970s. Critics might argue that our projections of accession demand are definitely hostage to continued high pay ratios, that is, that

⁷The projections do not take into account short-term policy adjustments that could affect retention, such as changes in reenlist-

services will sustain the trend toward a more senior force.

Between FY 71 and FY 78, the retention rate for fourth-year personnel went from 13.0 percent to 25.6 percent, an increase partly attributable to the higher reenlistment rates of volunteers. This near doubling in first-term retention created a "bow wave" of personnel moving toward the senior force. That wave is now entering the ten-year-plus service group; its numbers alone will raise the proportion of senior personnel and reduce the demand for accessions through the 1980s.

In addition, the large accession cohorts of 1976, 1977, 1980, and 1981 reached their first (and, in the case of the earlier groups, second) reenlistment points at times of poor civilian employment opportunities and high reenlistment

Increasing high-quality accessions. To offset the shift in the civilian wage structure, the services could begin targeting pay raises to junior personnel. However, as the youth population continues to decline in the 1990s, the differential between average civilian pay and youth wages could rise further. It might prove more cost-effective in the long term to continue using and to enhance enlistment incentives such as educational benefits and enlistment bonuses. Information derived from bonus and benefit experiments should prove quite valuable in formulating the best incentive package.⁸

Some potential exists for increasing high-quality accessions without significantly increasing resources devoted to recruiting. For instance, a recent Rand study indicates that

Rand's forecasts extend traditional assessment methods by tracing the effects that future rates of enlistment and retention will have on the entire enlisted force structure through 1990. This new analysis indicates that, despite the declining youth population and recovering economy, recruiting may not become the pressing concern it was in the 1970s.

bonuses. Members of those cohorts reenlisted at high rates and in very large numbers. This has magnified the bow wave and extended its impact well into the 1990s.

Finally, it seems unlikely that Congress will allow the military-civilian pay ratio to slip as low as the nadir of 1979. Consequently, actual retention, and thus accession demands, should fall somewhere between our projections under the high and low pay scenarios.

What will all this mean for high-quality accessions? The projected decline in their supply will occur over a period when overall accession demand should also fall. As a result, although the absolute numbers of high-quality accessions will decline, they should still account for approximately 50 percent of all enlistments. Between FY 76 and FY 82, they accounted for 43.7 percent of accessions.

Policy questions and options

These forecasts raise important policy issues. Although it is beyond the purview of this article to describe and evaluate them at length, we outline them briefly because most of them require immediate attention. The most critical questions are:

a major factor in the Army's recruiting successes of 1982 and 1983 was the restructuring of the Army's recruiter quota and incentive system.⁹ Another Rand study suggests that recruiting efforts would benefit from more precise information about the enlistment behavior of different groups, especially high school seniors and high school graduates who did not proceed to higher education.¹⁰ Such information would aid the services in tailoring enlistment incentives and bonuses to the groups they most want to attract.

Selectively increasing retention rates. Overall retention in the military may be less important than retention of people with certain skills, and the Selective Reenlistment Bonus program is available to reduce manning shortages in those skills. Analysis indicates that these bonuses can boost retention rates, and they are probably more cost-

⁸James N. Dertouzos, Recruiter Incentives and Enlistment Supply, R-3065-MIL, Rand Corporation (forthcoming).

⁹See, for example, Richard L. Fernandez, Enlistment Effects and Policy Implications of the Educational Assistance Test Program, R-2935-MRAL, Rand Corporation, September 1982.

¹⁰James R. Hosek and Christine E. Peterson, Enlistment Decisions of Young Men, R-3238-MIL, Rand Corporation

second-term reenlistees rose to 40 percent in 1982 but is now expected to return to lower levels, perhaps in the 10- to 20-percent range prevailing in the 1970s. Should shortages in critical skills grow rapidly, the Department of Defense would presumably request additional funds for the

coming smaller cohorts up, and perhaps relaxing end strength requirements.

If policy-makers want to modify the trend to a more senior force, they should act soon, while they have more leverage than they will in the late 1980s. In the next three

The projected decline in the supply of high-quality accessions will occur over a period when overall accession demand should also fall. As a result, although the absolute numbers of high-quality accessions will decline, they should still account for approximately 50 percent of all enlistments. Between FY 76 and FY 82, they accounted for 43.7 percent of accessions.

Selective Reenlistment Bonus program. Aggressive use of the system could blunt the effects of declining pay ratios and unemployment on retention of critical skills, lengthen the average term of commitment, improve the military's return on its training investment, and reduce accession demand.

The effects of a more senior force. Besides reducing demand for accessions, and thus counteracting the effect of a declining youth population, a more senior force has other potential costs and benefits. The structure of personnel costs could change significantly. Holding end strengths constant will require more money for basic pay and for retirement and in-service benefits, but smaller expenditures for training and supporting junior personnel through their relatively unproductive first and second years. Consequently, the force may become more productive and effective, particularly in areas where training and experience count the most.

Despite these benefits, a more seasoned force may require more retraining and cross-training of senior personnel. Adapting to such a force will certainly require active management initiatives to restructure job tasks and more closely align them with available personnel. Moreover, current grade-table limits will probably slow promotion rates, while the alternative—raising the limit on numbers of senior noncommissioned officers—will require a parallel change in definitions of job responsibilities.

Paradoxically, reduced accession requirements could ultimately become a serious obstacle to sustaining a more senior force. They may help maintain recruit quality in the 1980s but, if allowed to decline too far, will result in a trough within the senior-force population in the 1990s. This boom-bust cycle would lead to higher accession requirements later, when too much promotion has occurred

years, many of that large stock of personnel now in the five-to-nine years of service range will be making first or second reenlistment decisions. At these points rather than later ones, personnel management and compensation policies can more readily be tailored to trim the force and retain the most productive personnel. **DMJ**

JAMES R. HOSEK is director of the Rand Corporation's Defense Manpower Research Center, which conducts policy analyses on a wide range of issues concerning active, reserve, and DOD civilian personnel. Dr. Hosek's current research is in the areas of enlistment, retention, and training policy. He holds a bachelor's in English from Cornell University and received his doctorate in economics from the University of Chicago.

DAVID W. GRISSMER is deputy director of Rand's Defense Manpower Research Center and previously served as director of the department of policy analysis for the General Research Corporation. At Rand, Dr. Grissmer has managed and developed several projects in the military manpower area and has helped design manpower experiments and models used in managing the enlisted forces of the armed services. He holds a bachelor's degree in physics, mathematics, and philosophy from Xavier University and a master's degree and doctorate in physics from Purdue University.

RICHARD L. FERNANDEZ has been a member of the Rand Corporation's economics department since 1978 and has directed projects there on enlistment supply, enlistment standards, and officer retention. Mr. Fernandez holds a bachelor's degree in mathematics from Pomona College, a master's in economics from the University of California, Berkeley, and is a candidate for a doctorate in

A total-force approach to manpower planning

By DEBORAH CLAY-MENDEZ

In formulating accession policy, military manpower planners need to take full account of the interactions between active- and reserve-force programs.

The total-force policy, as explained in 1971 by then-Secretary of Defense Melvin Laird, recognizes this nation's need to plan for optimum use of all available military and related resources to ensure the security of the free world.¹ Military and related resources clearly include the National Guard and Selected Reserve forces, and under the total-force policy, the U.S. has begun to rely more heavily on those resources, which are larger and readier than ever before. In fact, during the past decade, reserve-component end strength has increased by 14 percent, while active-component end strength has fallen by 1 percent. Figure 1 shows the effect these trends have had and are projected to have on the mix of active-component and reserve-component personnel.

The most cost-effective mix of active and reserve forces has yet to be determined, but the trend toward increased reliance on reserve forces is likely to continue for at least the remainder of this decade. DoD plans call for a 16-percent increase in reserve-component manpower and a 5-percent increase in active-component manpower by FY 1989.² With the Congressional Budget Office projecting a federal budget deficit for FY 1985 of \$191 billion, Congress might press for an even smaller increase in active-component end strength and a still greater reliance on the reserve components.

As the strength and role of the reserve forces increase, so too does the need for carefully coordinated active- and

reserve-force planning. To ensure the cost-effective use of resources, manpower planners must address the impact of reserve-component programs on active end strength and the impact of active-force programs and policies on reserve end strength. Efforts to take such interactions into account have traditionally been on an ad hoc basis, without benefit of formal modeling.

For the active forces, however, DoD and the services have begun employing sophisticated projection models to evaluate the impact of alternative manpower policies. With the aid of the models, analysts can study the effect of factors such as enlistment incentives, reenlistment bonuses, pay, promotion opportunities, and changes in the retirement system; efforts are under way to develop similar capabilities for the reserve forces. The ultimate step must be development of total-force manpower planning models that allow explicitly for interactions between reserve- and active-component forces.

Because greater coordination between the reserve and active forces may soon be essential, accession planning is a logical area in which to begin developing total-force manpower models. The extent to which the reserve forces, including the National Guard, depend on nonprior-service recruits is frequently underestimated. In FY 1983, these

¹Melvin R. Laird, *Statement of the Secretary of Defense to U.S. House Armed Services Committee*, March 9, 1971, p. 21.

²Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics), *Manpower Requirements Report for*

viduals recruited for the total force that year.³

Although they may now draw from different subsections of the nation's youth population, active-force and reserve-force recruiters are likely to find themselves increasingly competing with one another. Projections indicate that between 1984 and 1992, the population of 18-year-old males will decline by 15 percent, from approximately 1.926 million to 1.634 million (see Figure 2, p. 12). As the recruiting climate becomes less favorable, both the reserve and the active forces may have to expand enlistment incentives in order to draw from a broader cross section of the available youth population. Recruiting costs will necessarily rise as a result, perhaps more than necessary, if the services do not coordinate active and reserve accession policies and enlistment incentives from a total-force perspective.

Consider some recent experience. In FY 1983, the Army National Guard failed to meet its recruiting goal for nonprior-service males by a considerable margin. Did the active Army's generous educational benefits program, available that same year, perhaps attract youths who would otherwise have chosen to combine school with a National Guard enlistment? To answer this and related questions, managers and planners must be able to perform total-force analysis of recruiting. Specifically, they need to identify and measure the impact of active-force recruiting incen-

val Analyses cost-benefit analysis of alternative Naval Selected Reserve accession policies for junior-enlisted (E-1 to E-4) personnel.⁴ It was one of the first formal attempts to analyze a military manpower problem from a total-force perspective. The analysis revealed that the relative cost-effectiveness of alternative Selected Reserve accession policies depends crucially on whether the impact of Selected Reserve accessions on the Navy active-component career force is considered. It highlights the interdependence of active and reserve manpower policies, and thus underscores the need for increased and improved total-force modeling. Although this analysis focused on Naval Reserve accession policies, the other services can use similar analytical frameworks to evaluate accession policies and other manpower issues.

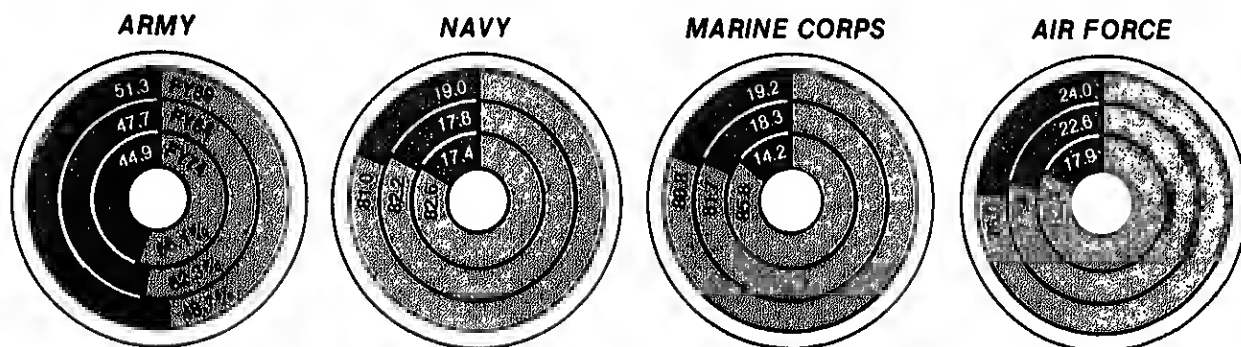
Current Navy plans call for a particularly rapid manpower buildup for junior-enlisted personnel in the Naval Selected Reserve. According to the office of the deputy assistant secretary of defense for program integration, this group's end strength is programmed to rise from an actual FY 1983 total of 26,600 to a total of 47,800 by FY 1989, an increase of almost 80 percent. Improved retention is ex-

⁴For the complete analysis see Deborah Clay-Mendez, *Alternative Accession Policies for Junior Enlisted Personnel in the Naval Selected Reserve: A Total-Force Analysis*, Center for Naval Analyses Research Contribution No. 500, September 1983.

³*Ibid.*

Figure 1. Impact of differing growth rates on the mix of active and reserve forces

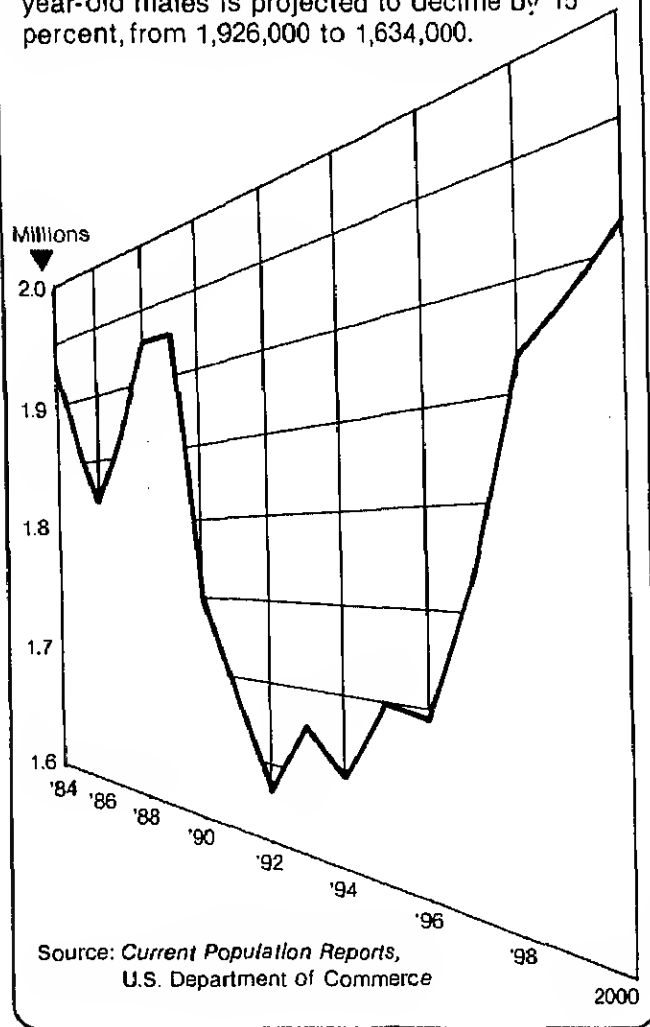
Under the total-force policy, Selected Reserve and National Guard end strength has increased by 14 percent since 1974 while active-duty end strength has declined by 1 percent.



PERCENT OF TOTAL FORCE

	Active Duty	Reserve and Guard
1974	70.0	30.0
1984	67.0	33.0
1992	64.5	35.5

Between 1984 and 1992, the population of 18-year-old males is projected to decline by 15 percent, from 1,926,000 to 1,634,000.



pected to bring about part of this increase; however, dramatic changes in accession policies will be necessary if the goal is to be met.

The Naval Selected Reserve benefits from two special programs specifically designed to provide junior-enlisted personnel. The first is a nonprior-service reserve enlistment program in which recruits spend six to ten months on initial active duty for training and then join a Selected Reserve drilling unit, where they remain until they complete a total of six years of service. From FY 1977 through FY 1983, an average of approximately 2,000 recruits signed nonprior-service reserve contracts each year. In an effort to boost junior-enlisted end strength, Navy officials increased the recruiting goal for this program to 10,000 in

program, under which nonprior-service recruits are obligated to serve three years on active duty followed by two years as drilling members of the Selected Reserve. (In both this program and the nonprior-service program, individuals spend the balance of their eight-year Universal Military Training Obligation as members of the Individual Ready Reserve.) During fiscal years 1977 through 1983, an average of roughly 15,000 recruits signed contracts each year under this joint enlistment program.

Even if the Navy reaches a level of 10,000 recruits per year under the first program, further increases in junior-enlisted accessions will be necessary if the Naval Selected Reserve is to meet its FY 1989 end strength goal. This context thus framed the question which the analysis of accession policies sought to answer: from a total-force perspective, which of the two programs, nonprior-service reserve or joint active-reserve, can more cost-effectively supply the Naval Selected Reserve's additional requirements for junior-enlisted personnel? A key factor to consider was that increases in recruiting for either program could negatively affect recruitment for the standard four-year active Navy enlistment program.

Historically, the Navy has had no difficulty meeting its goals for either the nonprior-service reserve or the joint active-reserve enlistment program. This fact suggests that the supply of these recruits is demand-limited, that is, the Navy could meet higher recruiting goals for the programs without allocating additional resources to the task. It does not mean, however, that such recruits are costless from a total-force perspective. If the high-quality high school diploma graduate youths (hereafter, simply referred to as high-quality graduates) who enter these programs would otherwise have chosen a regular four-to-six-year active Navy enlistment, any assessment of the cost of their recruitment must factor in the impact of forgone active Navy enlistments.

A two-stage regression procedure, applied to data from an existing recruit supply model, revealed that for each 100 additional high-quality graduate recruits obtained for the joint enlistment program, the regular active Navy program loses 80 high-quality graduate recruits. In other words, the analysis indicates that the joint active-reserve program can meet increased recruiting goals, but because of the competition between enlistment programs, approximately 80 percent of the joint-program recruits will be individuals who would have enlisted in the active Navy's standard four-year program.

From a total-force point of view, the next step was to determine the costs—in additional recruiting resources—of maintaining active Navy high-quality graduate enlistments

program is 0.8 times \$7,000, or approximately \$6,000. This figure represents the best estimate of the cost of additional resources needed to maintain active Navy enlistments when the joint program increases its accessions of high-quality graduate males by one.

The nonprior-service reserve program has been so small over the years that researchers cannot empirically estimate its impact on active Navy recruitment. However, because that program requires only a brief period of initial active duty for training, it may indeed draw from subsections of the youth population that are not drawn either to the regular Navy or joint active-reserve enlistment programs. If that is the case, the extent of competition between it and the other recruiting programs is probably less. In light of this, sensitivity analysis was used to determine the implications of marginal recruiting costs ranging from \$2,000 to \$6,000 for high-quality graduate males in the nonprior-service reserve program.

In addition to recruiting costs, training costs are a consideration in comparing the nonprior-service reserve and joint active-reserve programs. In a total-force analysis, both of these must be evaluated in terms of the average number of manyears that recruits in the two enlistment

recruits the sum ranged from \$11,000 (\$2,000 plus \$9,000) to \$15,000 (\$6,000 plus \$9,000), depending on what the marginal recruiting cost was assumed to be.

Determining the average number of years that nonprior-service reservists contribute to the Selected Reserve involved several steps. First, a search of records showed that of the cohort of high-quality graduate males who signed nonprior-service reserve contracts in FY 1979, 73 percent had become drilling members of the Selected Reserve by September 1981. The next step—calculating conditional survival rates for those who reached the drilling reserve—required data from a sample of 4,000 nonprior-service reservists who had reached drilling units during fiscal years 1977 through 1981. When integrated, the figures indicated that high-quality graduate males signing nonprior-service contracts contribute an average of 1.81 junior-enlisted manyears to the drilling Selected Reserve. (Because advancement from E-4 to E-5 is relatively slow in the Selected Reserve, all mandatory drillers with less than six years of total service were treated as junior-enlisted personnel.)

A cohort analysis of those high-quality graduate males

DoD plans call for a 16-percent increase in reserve-component manpower and a 5-percent increase in active-component manpower by FY 1989. With the Congressional Budget Office projecting a federal budget deficit for FY 1985 of \$191 billion, Congress might press for an even smaller increase in active-component end strength and a still greater reliance on the reserve components.

programs contribute to the Selected Reserve and the active-duty Navy.

The Naval Selected Reserve study used estimates of training costs and expected manyears for high-quality graduate recruits who had signed enlistment contracts guaranteeing specialized training. Calculations based on data provided by the office of the chief of naval education and training showed that the cost of basic recruit training plus initial skill training for a semi-technical Navy occupa-

who signed on as joint-program recruits (with training guarantees) in 1977 revealed that 42 percent had reached Selected Reserve drilling units by September 1981. Although this figure may seem low, fully 17 percent of the initial cohort later chose to change their enlistment program and consequently were still on active duty in September 1981. In fact, attrition rates for these joint active-reserve recruits during their initial three years of active duty were, if anything, slightly lower than the rates for comparable regular Navy recruits enlisted in FY 1977.

The next stage in the overall cost-benefit analysis was to apply the 42-percent rate derived for this cohort to estimates of conditional survival rates for a sample of 10,673

³Lawrence Goldberg, Enlisted Supply: Past, Present and Future, Center for Naval Analysis Study No. 1168, September 1982, p. 47.

ing units between FY 1977 and FY 1980. These calculations showed that high-quality graduate recruits signing joint active-reserve contracts contribute, on average, 0.64 junior-enlisted manyears to the Selected Reserve.

Were planners to ignore the contribution that nonprior-service reserve and joint active-reserve recruits make to

recruiting and training costs per manyear are approximately \$23,400 (\$15,000 divided by 0.64).

Under current law, the Navy could modify the joint program to require an additional year of Selected Reserve service. This change would, it is estimated, increase the

Accession planning is a logical area in which to begin developing total-force manpower models, since active-force and reserve-force recruiters are likely to find themselves increasingly competing with one another.

the active Navy, the former enlistment program would appear by a factor of 3 to 1 to be the least costly source of additional junior-enlisted Selected Reserve manyears. Since nonprior-service recruits contribute 1.81 expected manyears to the Selected Reserve, then the Navy bears between \$6,100 (\$11,000 divided by 1.81) and \$8,300 (\$15,000 divided by 1.81) in recruiting and training costs for each junior-enlisted Selected Reserve manyear provided through that recruiting program. In the case of the

program's expected rate of junior-enlisted Selected Reserve manyears per recruit from 0.64 to 0.8 and enable the Navy to save \$8 million annually in recruiting and training costs. Even so, recruiting and training costs per junior-enlisted Selected Reserve manyear would be approximately \$18,700 (\$15,000 divided by 0.8), well above the level for the nonprior-service reserve enlistment program.

The result is misleading, however, because it neglects the contribution that joint-program recruits make to the



as many many years to the regular Navy as they are to the Selected Reserve. Thus the true cost of reserve manycars is overstated if all recruiting and training costs associated with the joint program are attributed to the reserves. It was this problem that spurred development of a total-force approach.

The approach employs a simple linear programming model that allows analysts to assess the impact of alternative enlistment programs on both the active and reserve forces. The model is designed to set recruiting goals for each enlistment program—regular Navy, nonprior-service reserve, and joint active-reserve—at levels that minimize the recruiting and training costs associated with increasing junior-enlisted Selected Reserve end strength by 10,000, while holding active-duty career end strength constant.⁶

Net recruiting and training costs are lower when evaluated from a total-force perspective because 17 percent of



duty Navy and to become careerists. Given their contribution to the active-duty career force, increasing the number of recruits accessed into these special enlistment programs reduces the number of active-service Navy enlistments required to maintain the Navy's career end strength. Corresponding to this reduction in active-duty Navy enlistments will be a reduction in recruiting and training costs. This partially offsets the increase in recruiting and training costs that is due to higher nonprior-service reserve and joint active-reserve enlistments. The linear programming model also takes account of the extent to which reductions in active Navy recruiting eventually impact on the reserve. With fewer active Navy recruits, in the long run there are fewer Navy veterans available to affiliate with the reserves.

While the Selected Reserve faces a shortage of junior-enlisted personnel, the active Navy's main challenge is meeting career force end strength goals. For active-duty Navy forces, therefore, career end strength was the initial focus of the programming model. A more sophisticated

tively slight and unlikely to bias a comparison between the nonprior-service reserve and joint active-reserve programs. Results for induced changes in junior-enlisted end strength in the Selected Reserve were similar.

Due to the linear nature of the model, conclusions concerning net recruiting and training costs per reserve manyear are independent of the assumed 10,000-man increase in junior-enlisted Selected Reserve end strength. Those costs would have been the same had the assumption been 100 instead of 10,000.

As expected, estimated costs per Selected Reserve manyear provided through the joint program were much lower when the contribution of joint-program recruits to the active Navy was taken into account. If the Navy reduced recruitment for its standard four-year program so that active-duty career end strength held constant, it could increase junior-enlisted Selected Reserve end strength at a net recruiting and training cost of \$5,500 per manyear under the current joint active-reserve enlistment program. Were this program modified to have a three-year drilling

Joint-program recruits are obligated to contribute at least as many manyears to the regular Navy as they are to the Selected Reserve. Thus the true cost of reserve manyears is overstated if all recruiting and training costs associated with the joint program are attributed to the reserves. It was this problem that spurred development of a total-force approach.

total-force model might also include first-term reenlistment bonuses as a variable; analysts could then adjust bonus levels to ensure that the active Navy's first-term end strength would remain constant. However, such an extension of the simple model used in this analysis was not necessary. When recruiting levels were set so that active-duty

obligation, the net cost per junior-enlisted Selected Reserve manyear would be approximately \$4,300. Comparison of these figures to the estimates based on a partial-force analysis shows a reduction in reserve manyear costs by at least a factor of 4 under the total-force concept (see Figure 3).

Unlike joint active-reserve recruits, nonprior-service reserve recruits have no initial obligation to the active-duty Navy. Nonetheless, the total-force model also indicates that manpower flows between the nonprior-service reserve program and the active-duty Navy significantly affect the net cost of junior-enlisted Selected Reserve manyears provided through the nonprior-service program.

In fact, when active-duty career end strength was held constant, the model indicated that the net cost per junior-enlisted manyear provided through the program would range from \$3,800 to \$6,100, depending on the recruiting cost assumption used. Consequently, an analysis that ignored the contribution of nonprior-service reserve recruits

⁶Reference is to steady-state end strengths. Active-duty career end strength here includes length-of-service cells six and above, even though the conventional DoD definition extends to persons in their fifth year of service. Data on the survival patterns of recruits from different initial enlistment programs are scarce. Consequently, the model used in this analysis assumes that persons reaching the active-duty career force will contribute the same number of expected manyears to it regardless of the program they initially enlisted under. If persons in their fifth year of service were counted as careerists, such an assumption would be questionable because of the practice, one especially common among four-year obligors, of extending active-duty enlistment for one year.

Estimates of recruiting and training costs for Navy reservists can vary by as much as a factor of 4, depending on whether or not a total-force perspective is taken in the analysis. For complete details, refer to the text.

SOURCES OF ADDITIONAL SELECTED RESERVE MANYEARS	COST ESTIMATES USING TOTAL-FORCE ANALYSIS	COST ESTIMATES USING PARTIAL PERSPECTIVE
Joint active/reserve recruits	\$5,500	\$23,400
Joint active/reserve recruits, 3-year drilling obligation	\$4,300	\$18,700
Nonprior-service reserve recruits	\$3,800-\$6,100	\$6,100-\$8,300

to the active-duty Navy would overstate the true cost of Selected Reserve manyears provided through this program by as much as 60 percent. In evaluating manpower issues, planners should begin with the premise that interactions between the active and reserve forces are likely to prove important, rather than with the more conventional premise that they will not.

From a total-force perspective, neither the joint active-reserve nor the nonprior-service reserve program has a clear-cut cost advantage (see the first column of data in Figure 3). However, participants in the joint program do have valuable hands-on experience with the active Navy that nonprior-service reservists lack. As a result, the Navy, in its efforts to increase junior-enlisted Selected Reserve end strength, may wish to consider expansion of the joint program.

Nonprior-service reservists may pose problems for the Naval Selected Reserve that do not affect the other services. Naval reservists generally are not available for extended sea duty, for example, and providing them with adequate training platforms inland can be difficult. The data used in this cost-benefit analysis reflect these special factors; therefore, conclusions about the advantages of one reserve enlistment program over another do not necessarily apply to the other services.

But analysts could use a total-force framework similar to that presented here to address this and a variety of other manpower issues for each service. Officials simply need to identify manpower goals for both the active forces and reserve components and to consider explicitly interactions between reserve and active manpower flows.

Integrating the two will entail some problems. Because reserve-force data have not been scrutinized as closely,

they may not be as reliable as those relating to the active forces. Also, apparent inconsistencies, sometimes irreconcilable, will emerge due to differences in definitions and categories used by the active and reserve forces. Developing an operational model involves certain technical problems as well. A total-force model is necessarily more complex than a partial-force model because it must take into account the impact that policy changes have on both the reserve and active forces. Although linear programming proved adequate for the analysis discussed in this article, important nonlinear relationships characterize many, if not most, manpower problems.

Eventually, as we gain greater experience with total-force manpower models, we will be able to improve existing data bases and develop even better ones. Also, analysts will become more skilled at overcoming technical obstacles. Nonetheless, even in the face of existing difficulties, planners and policy-makers can derive more benefit from an imperfect model that takes a total-force perspective than from a superficially more elegant model that addresses only a portion of the total force. **DMJ**

DEBORAH CLAY-MENDEZ recently joined the staff of the directorate for manpower planning and analysis, office of the assistant secretary of defense (manpower, installations and logistics). Prior to this, she had worked with the Joint Economic Committee of the U.S. Congress and with the Center for Naval Analyses, where she was assigned to the manpower, support, and readiness group. Dr. Clay-Mendez holds a bachelor's degree in economics from Grinnell College and a doctorate in economics from Harvard University.

the cornerstone of excellence

By LAWRENCE J. KORB

A \$67 million capital investment that pays for itself the first year it is fully operational? That is only one of many success stories being written by innovative defense managers and employees in the push for productivity.

"Productivity gains do not just happen; they must be aggressively pursued." So declared Secretary of Defense Caspar W. Weinberger as he dedicated a Pentagon display of the department's productivity efforts during National Productivity Week.

Secretary Weinberger's observation underscored his personal commitment to expanding the productivity improve-

ment programs that have established the Defense Department as a productivity leader among federal agencies. The achievements depicted in the display were the culmination of several years of aggressive efforts by the services and defense agencies to do things better, more economically. This article reports progress to date on programs already developed and gives a glimpse of some in the offing.

PRODUCTIVITY THROUGH TECHNOLOGY

U.S. ARMY
SRADCOM

Multiple Launch Rocket System (MLRS)

Intangible Savings
Video vs Film

- Instant Verification
- Audio Documentation
- 100% More Rounds Fired per Day
- Reduced Range Time Usage
- Less Return of Rounds and Wares
- No Film or Tape Problems
- No Film or Tape Storage Problems
- No Film or Tape Handling Problems

Artillery Proximity Fuze

Hi-Speed Video for Proximity Fuze Tests

Better Automation for Soldiers

means of quality, quantity and uniformity of outputs and then uses the most efficient methods and organizations to accomplish those objectives.

Under this policy, the Defense Department has reviewed some 36,600 jobs since 1982, eliminated the requirement for 10 percent of them, and reallocated the resources to other unfunded requirements.

Overall, DoD has saved more than \$60 million through efficiency reviews. By 1990 we plan to review 1.3 million jobs and eliminate the requirement for 86,000 military and civilian spaces, a projected savings of \$1.49 billion. In turn, these freed or "saved" resources may be reapplied to valid but unfunded requirements.

The efficiency review process is a superior management concept to imposing top-down manpower ceilings which are not closely related to funded workloads and mission requirements. The department is using it as part of the effort to streamline GS 11-15 civilian position requirements instead of issuing specific controls on the number of GS 11-15 positions that each component may employ.

Funding initiatives. The Department of Defense has

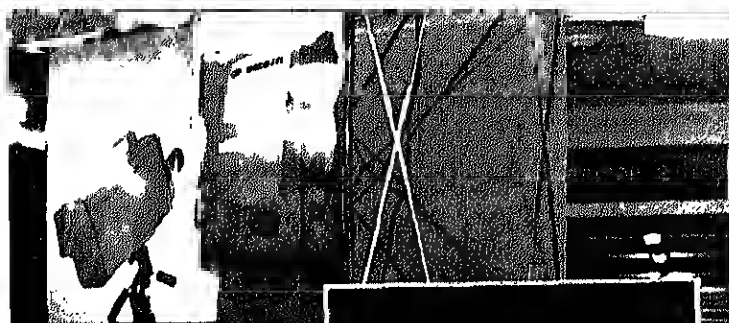
in the next four years, and program investment in production on modern technologies and facilities. By 1990, these productivity investments are expected to save \$2.6 billion. Projects selected for funding in 1985 and 1986 are projected to pay for themselves in less than two years and return about \$20 for each \$1 invested. Moreover, to encourage productivity-enhancing capital investments, DoD permits the services and defense agencies to reapply savings to valid, unfunded workloads.

Many of these productivity improvements directly translate into enhanced military capability through improved logistics support. The largest of these investments, \$67 million, went to seed money to apply machine-readable bar codes to supplies and equipment for various supply, maintenance, and inventory control activities throughout DoD. This effort, known as the Logistics Applications of Automated Marking and Reading Symbols, or LOGMARS, is expected to pay for itself within the first year it becomes fully operational; it has increased productivity by as much as 40 percent in areas such as spares management. Some of the prototypes for this system, which uses standard DoD 3-of-9 bar code technology, have demonstrated savings of 80 percent in time and money over manual inventory techniques. As a follow-on to this model, DoD is considering setting aside seed money to test the application of microcircuit (computer chip) technology to logistic operations.


The Air Force Systems Command used another \$1.2 million to develop an advanced office automation and word processing system that merges optical character readers with electronic typing equipment. Set up in late 1982, the system saved the command \$1.5 million within a year and it continues to save a million dollars per annum.

The Army spent—and recovered—\$1.9 million to modernize a facility that tests the effects of gamma rays emitted by nuclear weapons on military hardware. The improvement increases the types of simulation possible and permits testing of larger systems, including the space shuttle.

During National Productivity Week ceremonies at the Pentagon, the services displayed a variety of recent achievements. Depicted here are high-speed video cameras used by the Harry Diamond Laboratory to measure the effectiveness of artillery proximity fuses. The \$153,000 cost of this Productivity Investment Fund project was recouped in two months; Army expects to save more than \$9 million during the project's life.



U.S. ARMY



PRODUCTIVITY IMPROVEMENTS

TANGIBLE SAVINGS
Video vs Film

	Savings	Percentage of Reduction Video vs Film Costs
Initial Costs	\$205,000	6%
Amortized Costs	21,500	10%
Life Range Costs	646,500	7%
Video Reduction Time	1,200	6%

For an investment of \$153,000 the Army realized a savings of 40 work years and \$9.1 million over the 10 year life of the equipment. The original investment was paid back in two months.

Further, the productivity investment fund strategy has helped redress some of the department's critical spare parts problems. For example, the Navy expects a payback of more than \$18.8 million from its \$3.5 million investment in a facility that will manufacture electronic spare parts and support the design and fabrication of semiconductor integrated circuits. The facility will greatly reduce the support costs for many Navy systems that presently require expensive, low-volume parts no longer produced competitively in the private sector.

Smaller investments which pay for themselves within two years also enable the military services to do their job better. For instance, the Strategic Air Command spent \$30,000 on biometric rulers for three Air Force hospitals. By detecting ocular tumors and providing other valuable information to ophthalmologists, these rulers cut diagnostic costs and reduce patient referrals to private-sector health care facilities. Total savings are projected at nearly a quarter-million dollars.

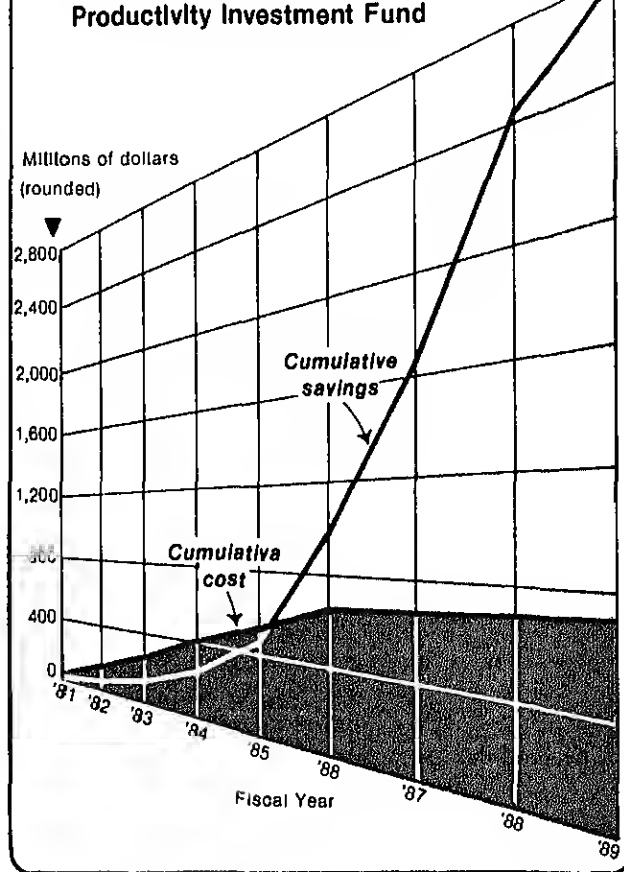
Given the success of these ventures, one can expect the use of productivity-enhancing capital investments of all sizes to continue. The FY 1986 Defense budget requests \$138.5 million for investments of \$100,000 or more and \$47.8 million for the smaller ones. DoD has also directed each of the services to set aside \$50 million for high-priority large investments.

This seminal drive to find more efficient and effective methods of accomplishing our missions will, we hope, generate more ideas on ways to apply evolving technologies to actual and projected workloads. The exceptional track record on current investments demonstrates that the department has only scratched the surface of the potential for improvement. It is part of management's responsibility to support funding for investments now in order to achieve long-term efficiencies.

Personnel. In all of these efforts to unlock the productivity of defense operations, people are the master key. Therefore, DoD is pursuing such strategies as participatory management, recognition programs, and incentive programs.

Efforts to tap the know-how of the work force are paying off. Quality circles are now a major movement in the department. Groups of five to fifteen workers from the same work area meet voluntarily with their first-level supervisor during normal duty hours to analyze problems associated with their work or working conditions and then recommend corrective action to management. First established in DoD in 1979 and now numbering more than 2,000, quality circles have made major contributions to

Productivity Investment Fund



For example, machinists in the "Triple Dence" Quality Circle at the Norfolk Naval Air Rework Facility are saving the Navy some \$400,000 a year; by reorganizing their tool room to serve their needs better, they eliminated a great deal of waste and inefficiency in stocking, issuing, and maintaining tools. Another circle at the Norfolk Air Rework Facility cut the cost of reworking wing seals for the F-14 aircraft by streamlining and standardizing procedures; they are saving the shipyard some \$300,000 a year.

Notably, the success of quality circles and other productivity efforts at the Norfolk Naval Shipyard helped the yard to win the non-manufacturing category of the first U.S. Senate Productivity Award presented in the Commonwealth of Virginia. Some 6,000 Virginia businesses competed for the honor.

Elsewhere, a quality circle at the Defense Logistics Agency's Defense Personnel Support Center simplified its routine transactions with the Food and Drug Administration, which evaluates and qualifies prospective medical contractors. The circle's recommendation saved an esti-

To date, return on investment in training and time devoted to problem solving through quality circles has ranged from \$4 to \$28 for each dollar invested. Other benefits include such intangibles as better morale, reduced absenteeism and turnover, and improved communication between labor and management.

The department also employs suggestion and recognition programs to encourage contributions from the work force. In FY 1984 alone, DoD employees achieved \$210 million in documented first-year savings through DoD suggestion programs.

To give special recognition to military and civilian workers who had major money-saving suggestions or special achievements, the Secretary of Defense created the Productivity Excellence Award Program in 1983. So far he has honored 49 persons with public recognition in Pentagon ceremonies. These employees, either as individuals or members of a small group, saved DoD \$1 million or more in first-year savings. Members of Secretary Weinberger's "Million Dollar Club" are from the Army (11 employees; \$7.17 million in savings); the Navy (22; \$42.28 million); the Air Force (14; \$68.01 million); and the Defense Communications Agency (2; \$5 million).

Since the award's establishment, an Air Force senior enlisted man and a Navy officer have been credited with the largest savings by individuals. Senior Master Sergeant Rodney J. Hindley, now retired, saved the Air Force Systems Command at Wright-Patterson Air Force Base, Ohio, \$32 million by proposing that the command update and modify F-15 and F-16 engines to be used for training rather than buy 10 new production engines. His suggestion earned him a special award of \$25,000. Similarly, Lieutenant Commander Larry F. Golden of Naval Station Norfolk, Virginia, avoided the \$8 million cost of refurbishing the RESOLUTE, a floating dry dock for nuclear submarines, by having the ship's capable crew do the work.

Gain-sharing. The department is also experimenting with various test and demonstration projects designed to motivate the work force to higher productivity and to recognize their successes accordingly. For instance, the Army, Navy, Air Force, and Defense Logistics Agency are currently testing and evaluating productivity gain-sharing experiments.

These programs are at the core of our efforts to make DoD a more productive organization. But we need to do more. We must build on them to take full advantage of every opportunity for improvement. Our near-term objective is to broaden the use of existing strategies and foster greater work force involvement. Research that improves our

Display available

The 10-panel display used to promote DoD's productivity efforts during National Productivity Week is now available to field activities. To make arrangements, call Dick Weaver, Defense Productivity Program Office, at (703) 756-2346 or AUTOVON 289-2346.

In line with Secretary Weinberger's commitment to accelerating and institutionalizing the productivity improvement process within the Department of Defense, the assistant secretary for manpower, installations, and logistics is sponsoring a senior-level task force of military, industry, government, and academic leaders; during the next year they will both assess the status of our manpower productivity policies and programs and recommend improvements that would further increase the mission capabilities of the armed forces. The task force includes active leaders of the military components who will be able to implement improvements and sponsor demonstrations of new concepts and incentive systems even as the work of the task force is in progress.

Planning is also under way for the first National Forum on Human Resource Planning for Private Sector and Defense Leaders on May 9-10. One of the primary issues specifically to be addressed is the identification and development of potential high-payoff areas in human resource productivity in DoD.

For all of these efforts to be truly meaningful, each member of the work force must share a personal commitment to productivity as a means of achieving a strong defense at least cost. By building on productivity, the cornerstone of excellence, we can all contribute to our mutual objective of improved readiness. **DMJ**

LAWRENCE J. KORB is the Assistant Secretary of Defense (Manpower, Installations and Logistics). Before assuming his present position, Dr. Korb was resident director of defense policy studies at the American Enterprise Institute for Public Policy Research and co-editor of the AEI Foreign Policy and Defense Review. He has also served on the faculties of the U.S. Naval War College, the U.S. Coast Guard Academy, and the University of Dayton. Dr. Korb has written several books and monographs on defense matters and has contributed some sixty articles on national security affairs to books and journals.

DoD's quality-excellence initiatives: from spares reform to streamlining

By WILLIAM H. TAFT IV

Recent reforms of the defense acquisition management system will ensure that current and future weapons procurements meet our security needs into the twenty-first century.

Four years ago, President Reagan, the Congress, and the American people made a commitment to restore and strengthen our national security. Immediate priority was placed on restoring the readiness and sustainability of our military forces while modernizing and expanding those forces to offset the growing and increasingly sophisticated threats to our security. At the same time, this administration committed itself to reforming our acquisition process to get the most defense from each procurement dollar.

To a great degree, we have met our initial objectives. The inefficiencies, uncertainties, and irresolution of the 1970s are behind us. Moreover, we have spent the past four years laying the foundation for improved security in the future. While the modernization of our armed forces is well under way, the development of new programs and technologies has also been initiated to meet our security needs into the next century. In addition, we have in place a management system that will ensure that current and future acquisition programs are efficient, effective, and reliable.

Having reached this plateau, we must not slide back into the inefficiency, uncertainty, and irresolution of the past. We must instead move forward to reap the full benefits of our investment. Postponing further modernization of our forces is a false economy, which not only costs us more in the long run, but will dilute the revived military strength we have worked so hard to achieve.

ment that works. Thus, quality must remain the keystone of our modernization efforts. To maintain an effective deterrent force, we must produce, deploy, and maintain high-quality weapon systems. The personnel who make up our armed forces deserve nothing less.

Quality, of course, is something that must be designed into our equipment. And to ensure quality and productivity from the design stage through production and support, we have integrated our most important quality initiatives into a new program. The Defense Industries Quality Excellence Program will provide the foundation for our long-term improvements. The following are a few of our initiatives under this program.

Streamlining. The quality of a weapon system is enhanced when we focus our efforts on its critical requirements. In the past, our requests for proposals contained thousands of detailed military specifications. These specifications prescribed how contractors were to accomplish specific tasks, making it very difficult for them to assess and recommend those requirements which were cost effective and truly needed.

Under our new streamlining initiative, we are telling contractors *what* is required rather than *how* to accomplish it. We are currently implementing this initiative on 12 major weapon systems, including the Air Force's Advanced Tactical Fighter, the Navy's Amphibious Assault Ship, and the Army's Light Helicopter (LHX). We have established streamlining advocates in each military service, and we will be adding more programs in the near future.

the efficient development and production of the system.

Test evaluation. Proper testing is also an integral part of quality and is essential to sound management of our acquisitions. In response to your interest in operational test and evaluation, let me give you a brief status report.

Pursuant to congressional direction, the Department of Defense created the office of the director, operational test and evaluation, in January 1984. The charter for the office was promulgated on 2 April 1984, and Brigadier General Mike Hall was assigned to manage the office until a director could be appointed. The president recently nominated Mr. John E. Krings to be the director, and his nomination is now before the Senate for confirmation. The office has been allocated sixteen manpower spaces to carry out its responsibilities; ten of the positions are filled. In order to allow the director to choose his own management team, we did not attempt to fill the senior civilian executive positions.

Despite the delay in naming a director, the test and evaluation office has been performing as specified in the legislation and is monitoring more than 150 major acquisition programs. The office is working with the services' independent test agencies to make sure that test plans are adequate to evaluate each system's operational effectiveness and suitability. It has also had observers present during the preparation for and conduct of operational tests. I should emphasize that the office does not conduct tests; each service has an independent agency that is responsible for designing and conducting operational tests for major programs. These agencies provide evaluations directly to the service chiefs, independent of any service research and development or procurement staff. These evaluations are also provided to OSD and, together with the results from all other tests of the system, form the basis for the director's independent operational effectiveness and suitability assessment provided to the secretary of defense and the Congress. The operational test and evaluation office has submitted three such reports on major weapons that have proceeded beyond low-rate initial production: The M1A1 tank, the Tomahawk, and the SM-2 standard missile system.

Warranties. Another area related to the quality of our weapons in which you indicated an interest is the use of warranties. First, may I remind you that the Defense Department has used warranties to ensure quality for its programs for many years. We continue to be responsive to the recent legislation which directs the expanded use of war-

ranties effective January 1, 1985. We issued interim guidance on December 24, 1984, because there was not sufficient time prior to January 1 to allow all interested parties to comment and then to publish a final version. We did, however, consult with the Armed Services Committee staffs of the House and Senate before we released our interim guidance.

Our interim guidance was published in the Federal Register on January 3, 1985, for public comment over a 60-day period, which ended on March 4, 1985. We are now reviewing the public comments, will incorporate them where appropriate, and then consult with Congress. Final guidance will be issued as quickly as possible thereafter. In the meantime, the interim guidance establishes our policies for implementation of the law.

There are other important elements of our quality-excellence program such as designing and building in quality, considering a firm's "quality history" in source selection, providing incentives to contractors to improve quality and productivity, and ensuring adequately trained personnel. I would be glad to answer any questions you may have about our work in these areas.

Controlling cost growth

As a result of this administration's successful economic policies and the effectiveness of the department's management initiatives such as competition and spare-parts procurement reform, we have already made significant headway in reducing the cost growth on our major acquisition programs. In particular, since early 1981 we have made very substantial gains in controlling the rate of cost growth. These gains are clearly shown in the July 1984 Congressional Budget Office special study entitled, "A Review of the Department of Defense December 31, 1983, Selected Acquisition Report." The budget office's analysis indicates in then-year dollars that the cost growth rate has declined from 14 percent in 1980 to 12 percent in 1981, 3.5 percent in 1982, and about 1 percent in 1983. In base-year dollars, the cost growth rate was about 7 percent in 1980, 7.5 percent in 1981, 2.3 percent in 1982, and less than 1 percent in 1983.

Another way to look at this analysis is to examine program acquisition unit costs. These are the same unit costs you require us to monitor in accordance with title 10, United States Code, section 139b, commonly referred to as the Nunn-McCurdy amendment. Since initiation of the

partment was being charged for unallowable overhead costs. Secretary of Defense Caspar W. Weinberger has directed the services, the Defense Logistics Agency, and the Defense Contract Audit Agency to review the overhead claims that major contractors have made against the government. Auditors will examine billings received from every contractor location where final overhead rates have not been established for prior fiscal years.

The initiative is intended to ensure that all major contractors comply with billing requirements and that DoD does not reimburse companies for any overhead expenses unrelated to government work.

Engine warranty boosts reliability

Officials at the U.S. Army Materiel Command are giving credit to a tough engine warranty with General Electric for high reliability rates on the UH-60A Blackhawk helicopter.

According to the command's director of product assurance and testing, the warranty on the aircraft's T700 engine has con-

tributed to a 10 percent reduction in flying hours. Today, the rate is 0.67 per 1,000 hours.

Under the warranty, General Electric pays for all repair costs incurred during the first 250 flight hours, while the Army and the contractor split the maintenance tab for the next 250 hours.

Army, Air Force name competition advocates

The Air Force and Army, es-

pecially the Navy before them, have established competition advocacy offices. As the Air Force's competition advocate, Brigadier General Gerald C. Schwankl will report directly to the assistant secretary of the Air Force (research, development and logistics). He is expected to continue the push for improved spare-parts procurement, which has experienced a twofold increase in competitively let contracts over the last two fiscal years.

The Army's first competition advocate is Brigadier General Charles R. Henry, assigned to the office of the deputy chief of staff for logistics. He will intensify the service's efforts to in-

crease competition goals, delineate organizational and personal accountability, oversee procurement training and seek ways to remove barriers to competitive procurements.

The Navy established its competition advocacy office in July 1983.

New data base aids parts pricing

The Air Force's acquisition management information system program office has created PRICES, an automated price history data base, to improve the service's ability to evaluate spare parts and support equipment prices.

Designed in response to an Air Force management analysis group action item, PRICES contains historical pricing information on 800,000 line items purchased under contracts issued or administered by the Air Force Systems Command. In the near future, the new data base will contain information on contracts awarded and managed by field procurement activities as well.

As enhancements become available, PRICES will serve as

simplify acquisition

Deputy Secretary of Defense William H. Tarr IV has announced the appointment of acquisition streamlining advocates for the three major services. They are Brigadier General Lynn Stevens (Army), Gerard Hoffman (Navy), and Colonel James Lindenteiser (Air Force). The advocates will accelerate and intensify service efforts under the DoD acquisition streamlining initiative, which was launched in December 1984 to eliminate unnecessary contract specifications and requirements. DoD contract specifications are now focusing more on system performance and less on the methods a contractor should follow in designing and developing an item.

The services have identified 12 acquisition projects for initial inclusion in the program. Among them are the Porshing II missile system, the undergraduate jet flight training system, the multipurpose amphibious assault ship, the advanced tactical fighter, the joint services advanced vertical lift aircraft, and the integrated electronic warfare system.

defense acquisition improvement program in early 1981, the percentage of systems in the Congressional Budget Office study experiencing unit cost increases dropped from 71 percent in 1981 to 55 percent in 1982, and to 27 percent in 1983. In addition, the number of systems requiring congressional notification because their "Nunn-McCurdy" unit costs had increased by more than 15 percent has declined from 24 in 1982 to nine in 1983, and to two in 1984.

The record is clear: The number of systems with unit cost increases is decreasing. How are we accomplishing this? The B-1B tells the story. In November 1981, the program was approved at a total projected cost of \$20.5 billion in 1981 constant dollars and \$29.5 billion in then-year dollars. Current estimates are slightly lower. Several factors account for this success. Foremost among them is

management oversight. The secretary of defense has received regular briefings on the program in his secretarial performance reviews. His direct involvement in this and other programs has emphasized the department's commitment to the management actions necessary to control program cost. Good initial estimates, firm cost baselines, stringent control of design changes, and reliable contractor cost and schedule data are some of the basic ingredients of success in the B-1B program and are inherent in our initiatives.

The military departments are also initiating management improvements to hold down costs. The Navy is moving to control shipbuilding costs by requiring independent cost estimates for all program reviews, increasing competition, controlling major engineering changes, and emphasizing fixed-price contracting.

views of prime contractors, systems and procedures to reduce labor hours and program scrap and rework. Controls also have been placed on the number of changes that can be made to a program. For example, more than 20 programs have been "baselined," meaning that the program manager must obtain approval from the under secretary of the Army to change the baseline. All such measures are intended to increase program stability and control cost.

The record clearly demonstrates that we are making significant gains in controlling acquisition costs of major weapon systems. Cost control will continue to be a high priority. Although efforts in a number of areas have contributed to our success in reducing the rate of cost growth during the past four years, two of the areas are of particular note. These are competition and spare-parts procurement.

Competition

Competition has been the preferred means for acquiring supplies and services in the government for generations. Increased competition was one of the original 32 Carlisle initiatives and it continues to receive high priority.

A number of measures, including our spare-parts procurement reforms, will enhance the use of competition in the acquisition process. Competition advocates are at work within the services and defense agencies to review areas where competition is being underutilized and to identify new areas where competition can be introduced. Competition goals have been established to provide an incentive to all buying organizations. Special management attention is being focused on identifying second-sourcing opportunities at the system and subsystem levels.

Our high-level working group on competition is examining ways to alleviate impediments to competition and increase competition at the subcontractor level. The new directive on competition, issued in August 1984, is an important product of the working group. This directive reaffirms the department's commitment to competition and accents the need for early planning and market research to enhance competition opportunities.

The passage of Public Law 98-369, Title VII, "Competition in Contracting Act," alleviates much of the concern about the traditional method of procurement. This act formalizes our determination to enhance competition. Most provisions of the act became effective April 1, 1985. We have issued implementing regulations. You may be assured that we are seeking every reasonable avenue to increase competition where enhanced quality and cost bene-

Spare-parts reforms

Increased competition is also a primary objective of our spare-parts procurement reform effort. So far, the results are very encouraging. In FY 1984, more than 211,000 items were screened for breakout to enhance competition. Nearly 48,000 items were broken out; 30,000 of these had never been purchased competitively. Another 57,000 items were broken out from the prime contractor for direct buys from the actual manufacturer. The net effect of these actions is reflected in the significant cost savings and cost avoidances we have achieved. We estimate that nearly \$1.2 billion in cost savings and avoidances were realized in FY 1984.

Significant progress in other management areas has also been achieved as a result of our efforts to implement Secretary Weinberger's spare-parts procurement reform program. Private industry is fully aware of our commitment to the taxpayer and has shown a high degree of cooperativeness. For example, we have received \$2.9 million in voluntary refunds from more than 250 contractors when overpricing has been identified. Concurrently, we have not hesitated to act against contractors who do not meet their legal obligations. Roughly 400 such contractors were suspended or debarred during the past year.

We also have taken a number of steps to ensure that the excesses of the past are not repeated. We have revised procedures to distribute costs based on item value. We have adopted "most favorable customer" contract clauses to guarantee us the best available price and have expanded the practice of requiring identification of manufacturers whose items we purchase. We have implemented stricter price screening procedures and have awarded 1,000 defense employees a total of \$350,000 for identifying overpricing infractions that otherwise would have cost us more than \$13 million last year. Finally, our aggressive audit program and effective hotline to prevent fraud, waste, and abuse have contributed to improved spare-parts procurement. **DMJ**

WILLIAM H. TAFT IV is the deputy secretary of defense. Previously he was DoD's general counsel. He has also served as a lawyer and administrator in increasingly responsible positions with the Federal Trade Commission, the Office of Management and Budget, and the Department of Health, Education, and Welfare. Mr. Taft holds a bachelor's degree in English from Yale College and a law degree from Harvard Law School.

Industry looks at the U.S.'s ability to surge

By RODERICK L. VAWTER

To evaluate defense contractors' ability to surge, DoD and industry recently joined forces in an innovative simulation exercise.

Is surge, defined as the rapid expansion of defense production in a national emergency, a practical possibility? What does it take to have a surge capability? In the summer of 1983, at the request of the Defense Department, representatives from U.S. industry conducted an Industrial Responsiveness Simulation in order to help answer these questions. The purpose of the exercise was to identify current production potential and options for enhancing that potential.

The Under Secretary of Defense for Policy, Dr. Fred C. Ikle, perceived a need to involve industry directly in assessing our ability to respond to an emergency demand for increased production of defense materiel. He assigned the task of creating and accomplishing the exercise to Sol Love, chairman of DoD's Industrial Base Task Force. The National Defense University's Mobilization Concepts Development Center, which was doing some related work, helped set up the exercise. A major goal of the simulation was to recommend actions that government and industry could take to provide the capability to surge. In particular, participants examined those factors likely to either enhance or detract from our capability to expand emergency production rapidly.

The premise underlying the Industrial Responsiveness

Simulation was that the industrial base could be far more responsive than commonly believed if the realities of the physically possible could be achieved. For various reasons, barriers to emergency production have come into being over the years. An objective of the exercise was to demonstrate the dramatic improvements in industrial responsiveness achievable by removing those barriers and implementing industrial preparedness measures.

Creative approaches sought

Industry itself is best qualified to identify its capabilities and constraints. Therefore, the guidance given to the simulation's participants was to determine the maximum expansion of production possible independent of any statement of demand from the government. Though structured to assure consistent results, the exercise granted industry absolute freedom in seeking creative, innovative approaches to increasing production in an emergency. No peacetime business-as-usual rules, regulations, reporting requirements, or design and acceptance test specifications were exempt from modification or waiver, provided the action proposed would save time.

Participants in the simulation were to assume a national security emergency which would transition to mobilization at some unspecified later time. The purpose of this stipulation was to assure that contractors not limit themselves when considering investments likely to be effective only briefly during later stages of the surge period. Each contractor was to determine the total number of items that his firm could produce in 18 months in the following three

Air Controlmen First Class J.E. Sheffer loads sonobuoys into a mount. DoD's Industrial Responsiveness Simulation showed that the equipment's manufacturers, Magnavox and Sperton, could increase production by a factor of 15; however, DoD also learned that both companies depend heavily on off-shore pro-

TOW 2
Phoenix C
Infrared Maverick
ALQ-99 Electronic
Countermeasure
Hawk
Sparrow
Sidewinder
Chemical Protection
Suite
Turbofan 30 Engine
F100 Engine
M113 Armored
Personnel Carrier
Bradley Fighting
Vehicle
AH-1S Helicopter
Sonobuoys

Hughes Aircraft
Hughes Aircraft
Hughes Aircraft

AIL
Raytheon
General Dynamics, Raytheon
Ford, Raytheon

Winfield
Prett & Whitney
Prett & Whitney

FMC

FMC
Bell Helicopter
Megnevex, Sparton

• Condition A—Adherence to all existing peacetime procedures, regulations, and laws as currently implemented.

• Condition B1—Waiver or modification, with justification, of peacetime procedures, regulations, and laws identified as impediments.

• Condition B2—Identical to B1 but with a prior get-ready period, that is, time to stock long-lead material and equipment.

The second two conditions, which required a departure from business-as-usual, represented the operative part of the exercise. In both, individual defense contractors were to critically examine existing rules and practices in order to identify legal, physical, procedural, and financial constraints affecting their ability to expand production rapidly. In addition to proposing rule changes, participants were to recommend investments that would enhance production during the 18-month surge period.

The Industrial Responsiveness Simulation focused on solutions that would provide faster production regardless of cost effectiveness. The assumption was that some cost penalties, considered on a case-by-case basis, would be an acceptable trade-off in an emergency. Time saved was the key criterion in evaluating changes proposed under conditions B1 and B2. In fact, the ground rules specifically did not call for final, definitive cost data. Rather, participants were to provide sufficient information to support the validity of the proposals and to allow comparison of the relative costs and benefits of specific proposals.

A short list of critical end items, developed by the Office of the Joint Chiefs of Staff and deemed essential in

Figure 1), but they interacted with and obtained information from their subcontractors in conducting the simulation.

Both the American Defense Preparedness Association and the National Security Industrial Association, two organizations that are very active in industrial mobilization issues, supported the Industrial Responsiveness Simulation. They obtained the participation of several prime contractors as well as the services of Blaine Shull, then vice president for manufacturing, Hughes Aircraft Company, who chaired an industry executive committee made up of representatives from each of the participants. The associations also coordinated the industry briefing and prepared and forwarded the final report based on that briefing.

Typically, each participating firm established a project team led by someone thoroughly knowledgeable about the item and its production process. Approaches to carrying out the simulation varied, depending upon factors such as the technical complexity of the item being studied, its production maturity, and the firm's experience with surge and surge studies. Each participant identified a monthly production rate achievable within the 18-month surge period, constraints to achieving that rate at the earliest date, and solutions that would eliminate or mitigate the constraints.

Participants showed much diversity in the solutions they proposed. Some firms were very conservative in their approach, others were much less so. Production quality testing, a major driver of time and cost in missile manufacturing, is a good case in point. A conservative proposal was simply to retain the testing regimen and acquire more test equipment. The lead time for obtaining test equipment as well as measures such as prestocking and maintaining unutilized or underutilized test capacity would then determine the production build-up. Other firms opted for an examination of testing requirements; reduction of those whose curtailment, in the companies' opinion, posed little risk to quality; and testing cutbacks that would increase through-put and reduce the need for certain additional test equipment. In each instance, the participant had studied the solution carefully and justified it explicitly in its final report. And each proposal was right in the judgment of the particular manufacturer concerned.

While the simulation was in progress, a response team from DoD visited the firms taking part to assure that they were carrying out the exercise according to the guidelines set down, to correct any misunderstandings concerning that guidance, and to encourage open-ended thinking. The team also disseminated lessons learned at one firm to the other participants. For example, when DoD staff learned

the missile and sonobuoy manufacturers depended heavily upon off-shore producers of electronics components such as integrated circuits.

Each firm conducted its study during the period from June 14 to September 2, 1983, and participants submitted their individual reports to the associations in early September. Blaine Shull convened a small group to draft a consolidated industry briefing based on the individual reports. The industry executive committee then prepared the final briefing and delivered it to the Industrial Responsiveness Simulation steering group on September 30, 1983.

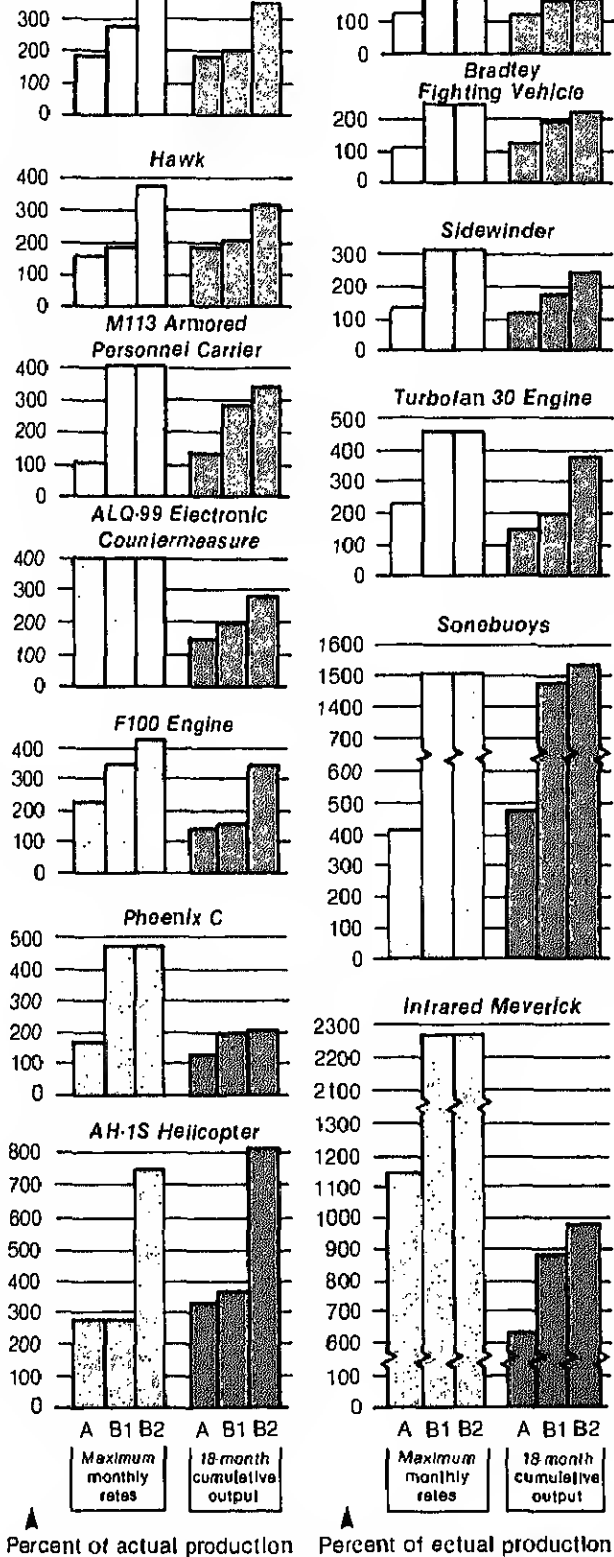
Results and findings

Figures 2 and 3 show the potential for production expansion identified by the participants. The production baseline against which simulation results are measured reflects contract deliveries forecasted during the 18-month period simulated. Because the Industrial Responsiveness Simulation was a production capability exercise, conducted independently of demand, the results permit no conclusions about the adequacy of projected increases to meet war reserve build-up or consumption needs in a national security emergency. Rather, the purpose of the exercise was to identify general production potential and measures that could enhance that potential.

Figure 2 presents production expansion capability for each item both in terms of monthly rates and cumulative output. The rates columns compare peak monthly levels forecast under each condition to the projected peak rate achieved during production. Similarly, the cumulative output columns compare total 18-month output projected under each condition to the total production output forecasted.

For condition A, the rate increases predicted range from very little—106 percent for the M113 armored personnel carrier—to quite dramatic—1,142 percent for the Maverick. Cumulative output varies from 121 percent for the Bradley Fighting Vehicle to more than 600 percent for the Maverick. Actually, figures for the Maverick were an anomaly because its baseline production rate was artificially constrained well below true capability at the time of the exercise. Outputs under condition A, which allowed no change of rules and assumed existing capacity, essentially represent idle capacity as of the time of the simulation.

Under conditions B1 and B2, participants explored the potential for expansion of production under other-than-normal ground rules and, in the case of B2, tested production capability predicated on investments made prior to the



lated, both in terms of rates and output, ranged from rather modest to very substantial. With the exception of the TOW 2, Hawk, F100 engine, and AH-1S helicopter, the peak rate achieved was the same for both conditions. But under condition B2, contractors reached the peak much sooner in the 18-month period, and the cumulative outputs implicitly reflect this fact.

As Figure 2 indicates, production of one item, sonobuoys, surged a remarkable 15-fold. That increase was possible because the sonobuoy manufacturers, Magnavox and Sparton, have an inherent ability to expand their production capacities quickly by acquiring additional facilities. Other programs, such as air-to-air missiles, which are much more sophisticated and expensive, exhibited less exciting increases. However, most items showed substantial upswings.

Figure 3 translates the cumulative outputs in Figure 2 into program values. Using a constant unit cost, analysts derived the values from straight-line projections. The figures therefore do not reflect the potential for lower unit costs due to production efficiencies. They are simply comparative.

The data in Figure 4 (p. 32) show, on an aggregated basis, the value of the baseline program under each of the Industrial Responsiveness Simulation conditions and the cost of acquiring additional production capability. Two elements comprise that cost—implementation, or outlays for new equipment and facilities, and inventory, or purchase of additional rolling stocks to support a build-up.

The projected value of the programs planned for the

city of reasons, including the perishability of such data and the costs involved in developing it. The purpose of the simulation was to develop a set of recommendations for follow-up action. Participants were to examine the range of potential increases obtainable in an emergency, the approximate associated costs and, most importantly, the barriers to achieving maximum production build-ups. Though the above data are not precise, they are valid indicators of the general level of production available in an emergency for this set of items. (The data do not cover chemical protection suits, which, due to the uniqueness of the item and the industry, required an approach different from the other items.)

Constraints on surge

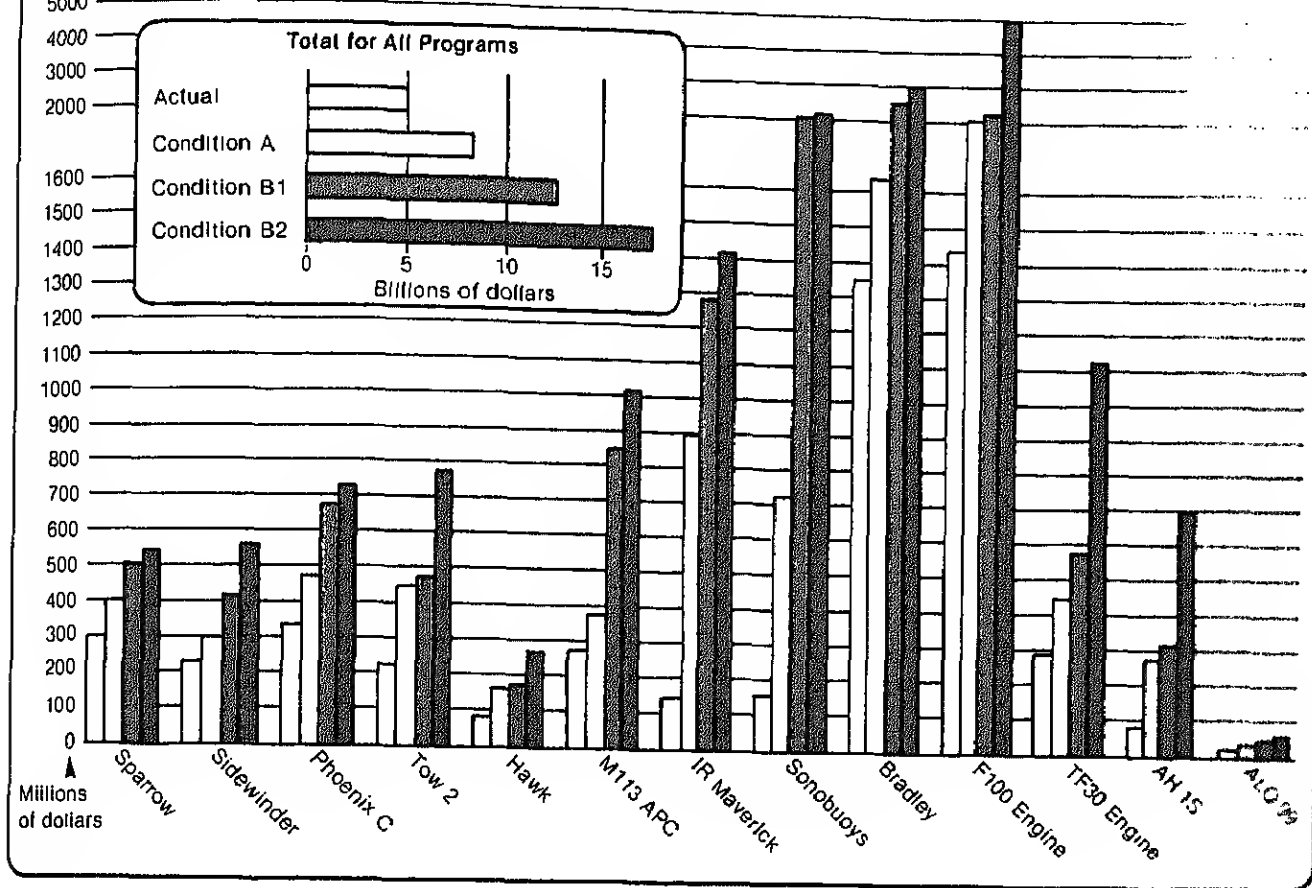
Contractors taking part in the exercise noted four kinds of constraints to rapid production—legal, physical, procedural, and financial. Within those categories, they identified 43 specific impediments and proposed some 76 different solutions.

Legal. Among the ten legal constraints cited were product liability, local limitations such as restricted land usage, and volatile emissions controls. For example, if the clothing industry were to mobilize in order to produce 30 million chemical protective suits, many companies not now engaged in government work would have to join the effort. But firms are often reluctant to take on government work because of product liability laws, which place, in the words of the industry, "enormous and undue burdens upon

The Industrial Responsiveness Simulation focused on solutions that would provide faster production regardless of cost effectiveness. The assumption was that some cost penalties, considered on a case-by-case basis, would be an acceptable trade-off in an emergency.

items studied was \$4.975 billion. Under condition A, with essentially nothing done to enhance capability, manufacturers could deliver materiel worth \$8.3 billion, a difference of \$3.3 billion. But an expenditure of \$546 million after the onset of the crisis would boost output over the 18-month period to \$12.5 billion, a difference of \$7.5 billion. And if money were spent early to get ready for the

government contractors." Under those laws, a third-party user of a product made in complete conformance with military specifications can sue the manufacturer, who has no recourse to the government for financial support. Given the nature of chemical suits and the inherent potential for this kind of problem, the industry believes that sophisticated manufacturers will not accept that financial risk with-



out some kind of government protection or insurance.

Physical. The participants reported 16 different physical restraints, most frequently problems related to tooling and test equipment capacity (at both the prime and subtier levels), material lead times, and vendor responsiveness. Production capacity, of course, was a basic concern. Modified requirements or specifications, particularly in the area of testing, can reduce processing time and thus stretch capacity, but only so far. Not surprisingly, most firms focused on the costs involved in eliminating capacity bottlenecks in their own and their subcontractors' production lines.

Factors relating to manpower, material, and components can also constrain capacity. A major problem, according to industry, is that subcontractors require long lead times to supply material and components parts. The most obvious and frequently offered solution was acquisition of rolling inventories for such items. The resulting costs, however, are quite substantial, notwithstanding the positive results that accrue.

One company proposed a very different solution to the

qualifying alternate production sources. Ascribed benefits included much less need for government funding of lead material, an expanded industrial base, and, over the long term, potential for reduced out-year production costs due to opportunities for competitive procurement. Costs to achieve a peak, 300-per-month production rate for a specific missile were \$102 million for prestocked material versus \$18 million for a combination of additional source and minimal prestockage.

Procedural. Of the 13 constraints in this category, seven were impediments to quick access to capacity, either existing or potential. They included priority ratings, testing requirements, configuration and change handling, delays in emergency construction approvals, production process delays, Federal Acquisition Regulations (formerly Defense Acquisition Regulations) requirements, and delays in bringing in additional capacity at the prime and subtier vendor levels.

For the last of these, participants offered six solutions, each of which addressed a different aspect of the problem.

	<i>Cost to expend Implementation</i>	<i>Added Inventory</i>	<i>Total</i>	<i>Program value</i>	<i>Delta</i>
Actual	—	—	—	\$4,975	—
Condition A	\$8	—	\$8	\$8,289	\$3,314
Condition B1	\$299	\$247	\$546	\$12,511	\$7,536
Condition B2	\$350	\$467	\$817	\$17,493	\$12,518

time-consuming formal demonstration and qualification of added capacity, waiver of the qualified products list and of source control requirements which limit the prime's access to a broader vendor base, removal of restrictive qualification testing requirements for vendor parts, and elimination of documentation and certification requirements which cause delays in placing orders. Also proposed was an increase in the competitive threshold of the Federal Acquisition Regulations from \$1,000 to \$5,000, thereby significantly reducing the number of purchase orders that would have to go through time-consuming competitive procurement.

The companies taking part in the exercise believed that many aspects of the Federal Acquisition Regulations would contribute to delays in an emergency. The regulations would, for instance, impose a burden on prime contractors who are at low production rates and need to significantly broaden their subcontractor vendor base. The government can issue letter contracts to prime contractors, but when a prime must expand or create a vendor base, the regulations effectively preclude him from issuing the same to his subcontractors.

In addition, numerous clauses in the Federal Acquisition Regulations—those on utilization of small businesses and on cost-schedule control systems, for example—require the vendor to demonstrate compliance with certain requirements, typically at some substantial expense of time. They effectively create a situation in which the prime can promptly execute contractual documents only with great difficulty. Moreover, many clauses have a basis in law, and some apparently have no waiver provisions; therefore, a declaration of national emergency will not necessarily

Few procedural issues raised during the Industrial Responsiveness Simulation are black and white. Virtually all requirements imposed by the government for peacetime acquisition of material exist for a legitimate reason. The question is, to what degree can these constraints be eliminated or mitigated in a national emergency?

Financial. To assure that the participating contractors identified all costs associated with surge, a basic operating assumption was that the government would fund any end items or actions required. Industry strongly emphasized that this money must actually be available in the event of a surge. Particularly important is preparatory cash funding for subcontractors, whose financial resources are often much less than those of primes. The timing in such circumstances is very critical, for the cost of the end item itself is not the only consideration; early on the subcontractor incurs costs to expand production capability. (See Figure 4 for expansion costs.)

Industry's conclusions

In its final report, industry drew three principal conclusions. The participants characterized them as good generic indicators but not truly definitive, since they were the product of a variety of responses to diverse programs.

First, prime contractors can increase production capacity and significantly expand output—at reasonable cost—subject to these liens:

- This finding may change as the economic situation changes. Production rates believed achievable in an 18-month period commencing September 1983 reflect economic circumstances at that time. Production forecasts for

studied. Although it required that the participants involve their subcontractors, the scope was not large enough to be representative of the demand during an actual emergency involving many more items.

- Continued complacent reliance upon off-shore, low-cost labor, certain unique foreign products, and coproduction could lead to major disruptions. Practices and circumstances of dependency that are normal and not a problem in peacetime could become serious problems in a national-security emergency.

- The private sector will not necessarily provide a production base adequate to develop and support capability for expanded military output. The jet engine industry is an example. The health of that industry and actions taken to maintain its cost competitiveness, domestically and internationally, will strongly influence military production potential.

- Critical materials, if not stockpiled and supplied as required, could halt production.

Second, the group concluded that the major determinant of output is the basic availability of production capacity at the prime and subcontract levels. Waivers and deviations that eliminate or mitigate constraints will accelerate production but, if not granted, will perpetuate major bottlenecks.

And third, preparatory cash funding, assumed for this simulation, is a must in order to build subcontractor capability and to support increased demands for subcontractor and prime working capital.

Fundamental issues

What does all this mean? What actually drives the availability of surge capability? Subsequent to the industry briefing mentioned earlier, the Mobilization Concepts Development Center carefully analyzed the consolidated and individual reports for the Industrial Responsiveness Simulation steering group. This analysis also drew upon the substantial body of dialogue which resulted from the visits to the various contractors. The center identified and the steering group subsequently adopted a number of fundamental issues that must be resolved if surge capability is to be more than a topic of conversation:

Surge capability. This ability is a function of available inventories of material and underutilized idle capacity at the prime contractor and his major subassembly vendors. In addition, the prime and his vendors must be able to draw from a robust, responsive subcontract industrial base.

Absent an economic incentive—in other words, current or future profit—private industry cannot be expected to acquire and maintain the idle capacity required to in-

A context of peacetime surge notwithstanding, mobilization experience heavily influenced the process of developing the Industrial Responsiveness Simulation. During World War II, U.S. industry performed miracles of production, at least partially because expedient solutions to difficult problems became the accepted rule. Whatever it took to expand production was done. From this historical base came the concept of bypassing business-as-usual in satisfying surge requirements today.

Also influential were lessons drawn from recent Joint Chiefs of Staff military mobilization exercises—NIFTY NUGGET in 1978, PROUD SPIRIT in 1980, and PROUD SABER in 1982. Each exercise underscored the absolute need to expand rapidly the production of materiel to supplement war reserve stocks and thus brought to the fore the issue of industrial mobilization. Although the Army hosted a discussion of mobilization issues by a group of chief executive officers in 1980 and led a surge study which included government visits to contractor plants in 1982, industry played no direct role in testing industrial responsiveness in any of these exercises.

Instead, the participants relied on production data then available in the system in dealing with industrial mobilization issues. When used with a scripted sequence of events to simulate real time, these data very probably yielded distorted conclusions about industry's capability to expand production. Little of the information reflected what was or might be possible if barriers to rapid production were minimized or eliminated. Moreover, because the typical sequence of events posited an early declaration of national emergency and, consequently, assumed that many constraints would be lifted, the exercises never properly addressed many issues such as environmental laws, which might cause production delays.

The Air Force's Blueprint for Tomorrow, a production base analysis prepared in 1983, was another effort related to the simulation. It too directly involved contractors in an examination of industrial capability. In particular, industry analysts sought to identify impediments to more efficient peacetime production among aerospace firms large and small. Subsequent to the completion of the blueprint, its tactical missile panel, consisting of nine prime contractors, agreed to participate in a study of precision-guided munitions sponsored by the Joint Chiefs of Staff. The purpose of this effort was to determine industrial preparedness measures required to achieve specific surge and mobilization capabilities for 20 precision-guided munitions.

capacities needed to meet emergency demand. It will also have to inform each affected manufacturer of that firm's

able and the new item has not come on yet? Witness the M60 tank in the early 1970s. When the Yom Kippur War

The companies taking part in the Industrial Responsiveness Simulation believed that many aspects of the Federal Acquisition Regulations would contribute to delays in an emergency.

requirement. And finally, the government must fund those companies at levels adequate to provide capability over and above current sales, that is, to pay for unutilized and underutilized capacity and for inventories of long-leadtime material and components.

Surge goals. The Defense Department must establish a formal surge policy. That policy would serve as a necessary precursor to establishing surge goals for specific items. For many items, industry and government have not reached a common understanding that a surge and mobilization capability is required and, therefore, to be pursued. Exceptions to this generalization include sonobuoys and munitions. Manufacturers of the former have participated in mobilization planning with government program managers and clearly understand the need to provide for increased production. Detailed requirements have always been available for munitions, particularly for ground munitions.

If the government requires surge capability for a particular item, it must establish production capacity goals very early in the developmental phase. Why? Principally because once decisions are made on sizing a production base and programming and budgeting, funding additional capacity several years later becomes much more difficult. An early decision on sizing must also take into account the need for concurrent logistical support in an emergency. Demand for increased production may well simultaneously increase the demand for maintenance, which will have to draw from the same industrial base for components and spare parts.

Once the Defense Department and the services agree to the surge capability requirement for a specific item, all interested parties must be responsible for achieving and maintaining that capability. In many instances, creating and maintaining surge capability is not a mutually agreed-upon task for the program manager and contractor. Unless this task is a stated responsibility, it will not get serious

drew down U.S. stocks, they could not be replaced in a hurry.

When the government sets a surge requirement, it should also tailor the funding mechanism for that program to the item being produced. Stretch-out buys are one option; direct payments for maintenance are another. Or, the government can allow industry to support a production base by recovering costs through spare-parts sales, an indirect form of funding. To avoid the recent controversy associated with spare parts, the government must clearly define what the surge production goals are and what it will do to support maintenance of minimum capability in an accountable fashion.

Prompt access to capability. The starting point for surge capability is capacity. The Industrial Responsiveness Simulation demonstrated that mechanisms, legal and procedural, must be in place to insure prompt access to available capacity, particularly in subtler industries. All interested parties need to understand the mechanisms which must be immediately available in circumstances short of war, that is, in a warning situation. To achieve this access, the government first needs to examine all the barriers identified in the exercise and develop solutions to be used in an emergency.

Solving some problems will prove more challenging than others; those relating to the Federal Acquisition Regulations, discussed earlier, are an example. A declaration of national emergency will remove some barriers but not all. Special solutions, such as standby legislation, may be necessary. Elimination of business-as-usual is not the solution to surge, but it is part of the solution and cannot be ignored. All the capacity in the world will do no good if the government cannot gain prompt access.

Funding. As noted above, surge will require an immediate commitment of money by the government. Some contractors will need funds to transmit to their subtler structure so that those industries can in turn react. Even

emergency are very substantial. The item itself and the capacity to be expanded. An emergency situation could easily exceed any DoD reprogramming authority or capability, especially if it struck late in the fiscal year. Therefore, mechanisms must be in place to obtain additional funding authority promptly from Congress. A reasonable first step might be development of crisis standby budgets, a possibility now under consideration by the Mobilization and Deployment Steering Group.

Productivity. Strong pressures exist within DoD to reduce costs by increasing productivity through capital investment. Private industry experiences the same pressures, perhaps stronger, in order to remain competitive in nondefense business here and abroad. But if not considered up front, drives to increase productivity could actually reduce rather than enhance surge capability.

New capital equipment is often very expensive. Therefore, cost optimization may dictate operating that equipment on a multishift schedule, a step that can create bottlenecks and thus reduce surge capability. Currently, for example, use of expensive test cells often leads to such bottlenecks, and future investments in capital-intensive manufacturing equipment are likely to aggravate the problem.

As flexible machining systems become more prevalent, they may allow manufacturers to meet surge and productivity goals concurrently. Such systems open the possibility of producing multiple components on short turnaround, thereby providing more flexibility than several pieces of limited-capability machinery. Not enough flexible systems are in use yet to permit a definitive conclusion. Whatever the ultimate resolution of the conflict, we cannot allow cost-saving goals to totally override surge goals.

Foreign source dependency. Over the years, U.S. policy, if not absolute practice, has been to depend upon domestic sources for defense production capability. Statutes such as the Strategic and Critical Materials Stockpile Act, the National Security Act of 1947, and the Defense Production Act embody that policy, as do executive orders and defense mobilization orders. Restricting defense production to domestic sources is also common sense. Without controls or coercive mechanisms, the nation cannot dictate production of U.S. needs in a future emergency or conflict. What's more, in the future, U.S. national security objectives may not coincide with those of our allies.

Currently, however, we rely heavily on foreign sources for some militarily critical items. The situation is a natural effect of economic interdependence, and the trend across the economy is toward more, not less, foreign dependence. Witness cars, steel, consumer electronics, and

Material Stockpile, as required by law. Our vulnerability in manufactured goods is no different, conceptually, than that in raw materials. The nation must find effective remedies for protection from foreign source dependencies, regardless of the difficulty of the task and the probable cost.

Follow-on

In February 1984, Mr. Love briefed Dr. Ikle and the Mobilization and Deployment Steering Group concerning these issues and other findings and results deriving from the simulation. He emphasized several key points:

- With a few obvious exceptions, surge, or the ability to expand production rapidly, is not an up-front part of DoD's normal approach to procurement. Therefore, current business-as-usual surge capabilities are marginal for many items.

- The nation can obtain surge capability at reasonable cost if the government sets policies and provides funds to assure the availability of physical capacities.

- The nation can acquire surge much more rapidly during an emergency if it acts beforehand to allow prompt access to the physical capability inherent in the national industrial base.

Mr. Love proposed that the Office of the Secretary of Defense address the fundamental surge issues and the constraints identified by industry during the exercise. The Mobilization and Deployment Steering Group agreed, and the Deputy Secretary of Defense, William H. Taft IV, subsequently signed a letter endorsing the Industrial Responsiveness Simulation findings. He also tasked various elements in the Office of the Secretary of Defense to address both the policy implications of the issues and the constraints and to recommend corrective actions. Substantial progress is expected before PORT CALL, the next mobilization exercise. **DMJ**

RODERICK L. VAWTER is a senior fellow with the Mobilization Concepts Development Center of the National Defense University. He joined the center at its inception in 1982 and served as its representative to the Industrial Responsiveness Simulation. As a long-time staff member with the Department of the Army, Mr. Vawter also worked on industrial mobilization policy and programs. A 1981 graduate of the Industrial College of the Armed Forces, he is the author of Industrial Mobilization: The Relevant History, published by the National Defense University Press in 1983. Mr. Vawter holds a bachelor's degree from Illinois State University.



Serial number tracking is more than a numbers game

By ROLAND E. BERG

Automation of serial number tracking is helping maintainers keep pace with the requirements of ever more sophisticated weapon systems.

When today's consumer checks out at the supermarket, a computer scans his or her purchases and reads the bar code on each item. That code tells the computer what the item is and its price. In addition to "ringing up a sale" on the register tape, the computer carries out various other transactions. It adjusts inventory and stock records and, by means of preprogrammed analysis, monitors trends in sales. Merchants are simply making sound business use of an automated process known as serial number tracking.

The Defense Department is doing the same. The military services are affixing serial numbers and bar codes to selected parts, components, and end items; as a result, they are better able to manage maintenance of weapons systems and equipment. They can conveniently store and easily recall information such as location, date of manufacture or installation, and the history of malfunctions and corrective actions. Serial number tracking offers the defense maintenance community an efficient, systematic approach to data entry and collection functions.

The tracking process

The tracking process has evolved over the last three decades in the commercial airline industry and in the military departments. Defense applications were originally a response to the operational requirements of sensitive or high-cost systems such as nuclear submarines, aviation engines, and aircraft components. Thanks to these applications, maintainers are now able to increase the service life of many systems by anticipating failures and taking preven-

tional benefits, serial number tracking programs can yield substantial savings.

Whatever the weapon system, during some phase of acquisition, deployment, or operation, the time comes when an unforeseen problem, actual or suspected, surfaces. When it does, the ability to locate the component or part and examine its maintenance history quickly is critical. A response unencumbered by time-consuming trial and error can reduce or eliminate equipment downtime, maintenance manhours, and costly disassembly of systems and equipment.

Serial number tracking facilitates such a response. For selected components it records all significant maintenance events, including delivery, installation, removal, repair, and modification. Technicians can recall that data to support their analysis of current maintenance problems, and they can use it to forecast potential problems as well.

Commercial airlines began tracking maintenance information on the DC-4, -6, and -7 and Boeing Cruiser aircraft when the Federal Aviation Administration required that they do so for safety reasons. Ultimately, this tracking capability allowed them to initiate the very successful reliability-centered maintenance techniques that the defense community subsequently adopted in the early 1960s.

Like the private sector, the Department of Defense has been tracking maintenance data, officially and unofficially, for nearly three decades now. Without the assistance of sophisticated computer technology, however, DOD's approach has necessarily tended to be labor-intensive and error-prone. Personnel have collected and recorded the data manually and forwarded them to a ph

analysis. The information has tended to be out of date and, because of inadequate manual editing procedures, to contain too many errors.

But the revolution in data processing technology has changed the information environment. Moreover, the increasing costs of new weapon systems make it prudent to invest in programs that reduce maintenance costs and improve readiness. The more sophisticated and expensive the system or piece of equipment, the greater the need to know the precise location and current maintenance status of high-value components in it. That information facilitates smart maintenance planning trade-offs and timely reaction to any condition that has an adverse impact on readiness.

If a failure is directly related to a production process or design defect, management needs to know the potential impact on total inventory. Consider, for example, a specific lot of accelerometers in an actuator assembly. The components, used in the guidance sections of missiles and ship navigational systems, are defective due to faulty manufacturing or a material defect. A manager can minimize the impact on total inventory if he is able to determine the exact location of each accelerometer by serial number. Tracking allows him to screen the suspect from the total population quickly.

This enhanced ability to react to emergent maintenance problems is one major benefit of serial number tracking. Maintenance managers and design engineers also value it as a tool for examining the maintenance history of system components. They can use it to pinpoint areas in need of maintainability improvement and to develop appropriate remedial action. As management analyzes historical trends over time and becomes aware of anomalies in a system, it can eliminate individual components or parts that are defective or that fail to meet performance specifications. The programs discussed below will illustrate these and other benefits, direct and indirect, of the tracking process.

The military departments use serial number tracking in various forms. The maintenance policy directorate in the office of the assistant secretary of defense (manpower, installations and logistics) recently analyzed four sample service programs in which serial number tracking, tailored to a specific system, resulted in either significant savings or enhancements to readiness. Analysts found that four general categories of requirements characterized successful programs; elements from one or more are common to each:

- Serious reliability, maintainability, or logistics concerns, that is, conditions requiring intensive management or additional engineering resources to develop solutions.

- A requirement for configuration management control in order to isolate and diagnose the cause of failures.

- Information needed in order to comply with certain warranty and incentive programs.

Though each program studied was unique, data accuracy and timeliness were common to all four and essential to their success.

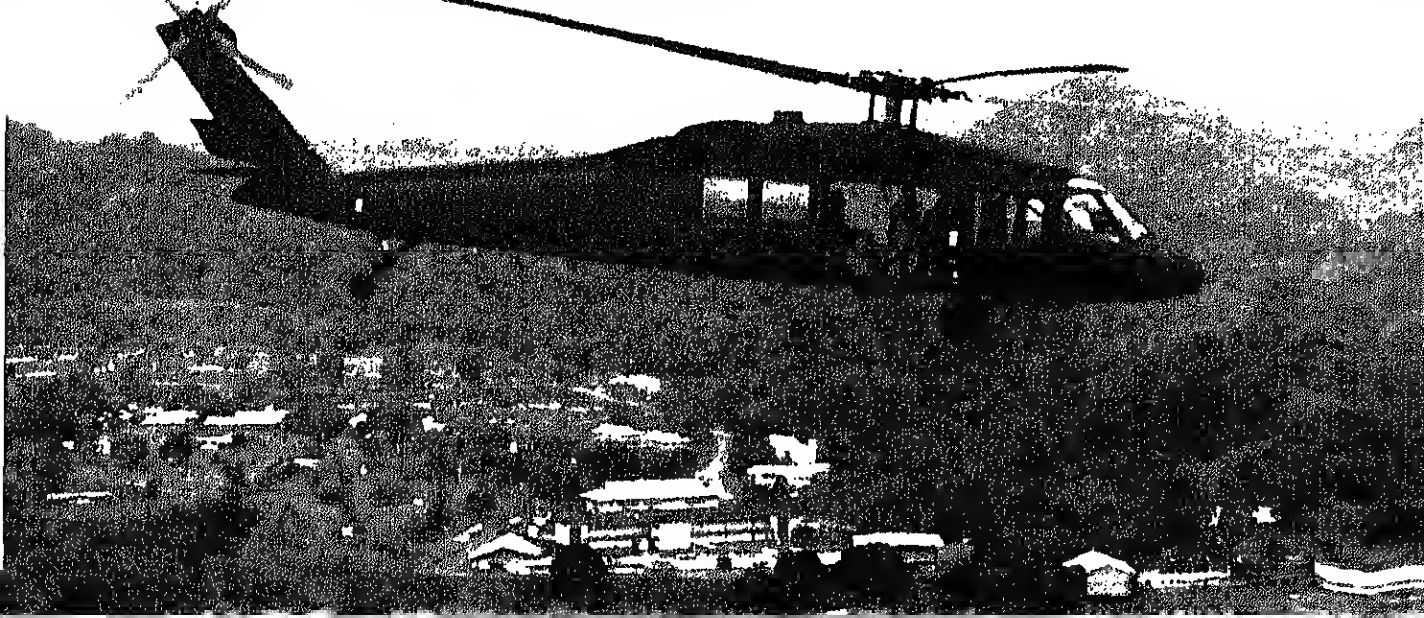
The C-5A

At Dover Air Force Base, Delaware, where the 436th military airlift wing maintains C-5A aircraft, the propulsion branch uses an automated maintenance system to track more than 450 items on the craft's TF39 engine. The system records maintenance actions on specific engine parts and thus often provides failure indicators that trigger preventive maintenance actions. With the automated tracking systems in place, the wing has been able to reduce parts consumption by 20 percent over a three-year period, decrease the mission abort rate by 89 percent, trim maintenance manhours per flying hour by 20 percent, and boost data accuracy to better than 95 percent. Reduced parts consumption has resulted in savings of \$8 million per year, and the reduced maintenance manhours translate into annual savings of \$700,000, based on current utilization rates.

The automated maintenance system at Dover is a real-time, on-line data system with full editing capability. Designed and implemented as an official service program, it is fully compatible with all standard Air Force data systems with which it interfaces. Data repository for the system, which employs a central data base concept, is at Tinker Air Force Base, Oklahoma.

The system's accuracy—and thus its success—is largely due to its editing and feedback features. One function of the former, for example, is to assure that every documented replacement action has a corresponding removal action. In addition, the editing feature permits a comparison of all input data to master records such as master configuration and serial number files. Immediate feedback concerning the status of components contributes to accuracy too. Because the information is actually useful to the person reporting and recording it, data entries are more likely to be error-free.

C-5A maintenance personnel report that serial number tracking has improved mission accomplishment on numerous occasions. Once, for example, while performing intermediate overhaul of TF39 engines, the crew inadvertently mislaid the seal on the fan shafts. This error could have



The ability to monitor and control the configuration of engines, modules, and components was an important feature of the serial number tracking system on the T700 engine, which powers the Blackhawk helicopter. The Army now stocks spares for the engines at a rate of 15 percent of total installed engines, down from the previous rate of 25 percent.

an in-flight shutdown of the engine. But because the automated system tracked TF39 engine parts by serial number, maintainers were able to identify the reworked engines by specific work orders, quickly determine the exact location of the defective part, and remove the engine from service for repair. Had they not been able to localize the problem to a specific group of aircraft, the entire fleet would ultimately have been suspect and subject to inspection.

F-16 warranty

Serial number tracking was also instrumental in the success of the Air Force's reliability improvement warranty contract with Westinghouse for the F-16 radar. Under the contract, Westinghouse was responsible for intermediate- and depot-level maintenance through January 1981 and December 1982, respectively. A key provision of the warranty required that the contractor meet a 22-day depot turnaround time for the six line-replaceable units as well

as all shop-replaceable units. That time period yielded the optimum payoff in enhanced readiness, given the cost of the aircraft and the budget available for it. In order to turn the units around in 22 days, the program manager had to make and track certain reliability and diagnostic improvements.

These design changes meant that reconfiguring the radar and tracking the performance of the various configurations would be a critical task. While the Air Force's maintenance data collection system could provide the data required, it could not do so quickly enough. The program manager needed a real-time, comprehensive maintenance management information system. Only a specially designed serial number tracking program would give him this capability and thus allow him to comply with the 22-day turnaround warranty.

To set up the program, Westinghouse decided to adapt an in-house form which its field and depot maintenance personnel could directly control at the company's Hunt Valley, Maryland, facility. The system supplied Westinghouse technicians, on a near real-time basis, with the configuration of each arriving line- and shop-replaceable unit, allowing them to quickly schedule the components for configuration updates and repair. The technicians also attached the information from this serial number tracking system to all components shipped back to field units so that field personnel could match like configura-

not was available to designers, and the impact of design changes, and to field teams, who used it to troubleshoot problems.

Blackhawk T700 engine

As in the case of the F-16 radar, reliability and maintainability requirements on the T700 engine, produced by General Electric for the Army's Blackhawk helicopter, were quite stringent. Therefore, the service let a reliability improvement warranty contract with the manufacturer. The provisions were similar in many ways to those for the F-16 radar; they included configuration control, quick depot maintenance turnaround, and prompt corrective action. To implement them, General Electric needed the capability that serial number tracking could provide.

In evaluating several different configurations while a design is still evolving, configuration control is vital. The contractor and the Army agreed that serial number tracking was essential to the success of the reliability improvement warranty effort. It allowed the program manager to correlate configuration and design changes with changes in performance and thus document the results of reliability enhancements. In this case, the service itself developed and maintained the tracking system. It took an Army form already being used to track engines and components—the comprehensive record for intensive management—and added the data fields necessary to track the reliability improvement warranty.

Eventually, Army personnel tracked more than 100 components on each of 300 helicopters, plus spare parts, for a total of some 40,000 items worth in excess of \$1 billion. Two people, one full-time and one part-time, were able to maintain the data base, thanks to the cooperation of field maintenance personnel, both from the Army and the contractor, in providing accurate and timely input. In fact, field personnel at both the unit and depot levels became key users of the system and thus played an active role in assuring the validity of the data.

The ability to monitor and control the configuration of engines, modules, and components was an important feature of the T700 serial number tracking system. Both maintenance and supply functions benefited from this capability, which proved useful daily in mating modules with configurations similar to those of the end item. Tracking the operation of time-limited components was another key feature. It allowed program personnel to avoid premature condemnation, to match components with like items during the T700 build-up process, and to plan maintenance and inspections in advance.

Army. In just a one-month period, the staff found that the supplier was inadvertently selling \$200,000 worth of components to the Army for the second time. The service traced the problem to a collocation of the production and overhaul lines and established controls to ensure separation of new from repaired equipment. Under the old procedures, personnel assigned the same part numbers, not individual serial numbers, to similar components and consequently could not track specific, individual components. Serial number tracking essentially eliminated the problem.

Overall, the tracking system has been a resounding success for the T700 engine program, which has logged 250,000 operational hours to date. The shop-visit rate is three to four times better than the visit rate for engines of the 1960s, and maintainability measures are better still. Moreover, the Army now stocks spares for the engines at a rate of 15 percent of total installed engines, down from the previous rate of 25 percent; this lower level means savings in excess of \$100 million. Serial number tracking helped make this achievement possible because it enabled managers to monitor the performance of items by manufacturer and by lot, thereby facilitating isolation of diagnostics problems and their causes. The Army could then more closely match spares ordered with actual requirements. Results under the program were so encouraging that the service developed a standard serial number tracking system and is testing it on the Apache advance attack helicopter.

Submarine maintenance monitoring

Unlike the two programs implemented for specific time periods in conjunction with reliability improvement warranty contracts, the Navy's submarine maintenance monitoring system is a long-term project and an integral part of the nuclear submarine maintenance system. The principal impetus for setting up the system was development of the long-life core nuclear engine, which essentially doubled the refueling interval for the nuclear fleet. This extended operating cycle, combined with a built-in design margin on other subsystems, forced the Navy to change its maintenance strategy. The new approach focused on two events: shipyard overhaul and an extended refit period, to be conducted at the home port instead of the shipyard.

The objective was to maintain the engineering baseline in order to ensure mission success and safety. The Navy decided to develop a very detailed maintenance planning system that would allow the service to schedule in advance a high percentage of home port extended refit maintenance. Submarine maintenance monitoring, which was rate and

information system technology provides timeliness. submarine maintenance monitoring system has been well for the Navy. Designers and engineers have data to improve the reliability of specific components and parts, and as a result, the service has been able to reduce the frequency of extended shipyard overhaul from four- or five-year to eight-year intervals. That reduction translated into significant savings.

In addition, serial number tracking has been an aid in planning and controlling extended-cycle maintenance and scheduling replacement or repair of life-limited components. The information gathered has also helped engineers establish baseline performance values on new or modified components in order to ensure that mission accomplishment and safety are not compromised. The Navy is adding substance to the program and, with the completion of up-grades now under way, hopes to be able to increase the productivity of the engineering staff.

Where do we go from here?

Lessons learned from these and other prototype programs have provided a solid foundation for greater use of serial number tracking. The programs just discussed are a mix of needs unique to each weapon system and are not initially envisioned as continuing efforts. Future serial number tracking programs will keep tabs on more components and yield data accessible to a wider range of activities. They will also track software configuration changes; many systems do not. In addition, as the services upgrade their maintenance data collection systems, they will incorporate serial number tracking modules into them. For example, the Air Force is now developing a core maintenance system designed to improve aircraft system readiness and reliability. It will provide a central aircraft status reports, accurate historical data, and workload management for front-line supervisors. It will also collect data needed by the Air Force Logistics Command to manage weapon systems worldwide. The system will run on the new Phase IV computers being installed at Air Force bases throughout the United States and overseas. It will also interface with the B-1B aircraft test subsystem ground processor and will facilitate the maintenance of approximately 500 flight-critical and high-priority aircraft. Field testing began in February 1985 at Dyess Air Force Base, Texas, and each major Air Force command will eventually receive a test system.

The Army is also working on a new serial number tracking program, which it calls the "aviation intensive

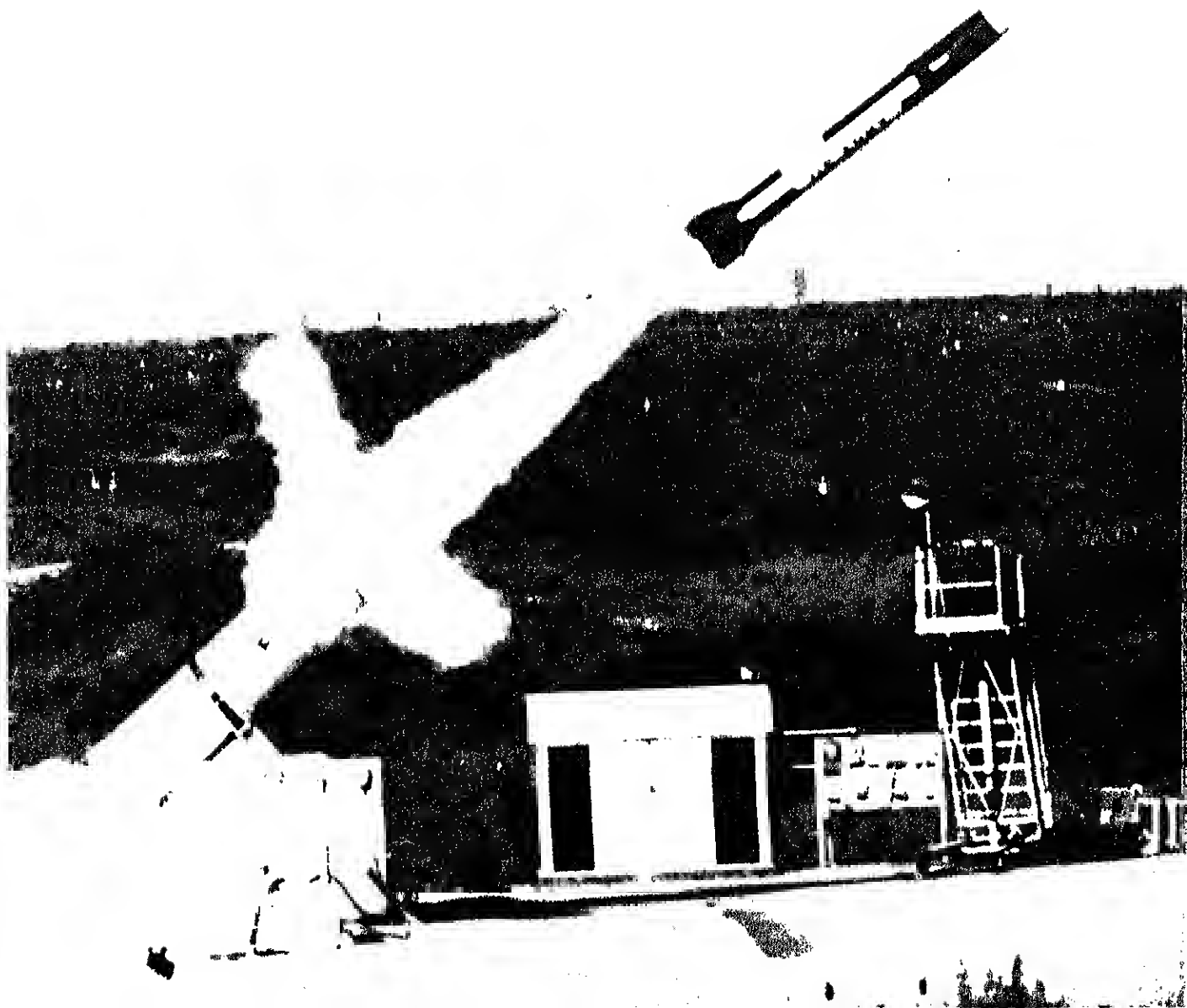
and plans to test it with serial number tracking program for the M-1 tank.

The Navy aviation community is designing serial number tracking systems that can provide real-time interface between the supply and configuration management control functions. This feature will make possible immediate, accurate updates to maintenance and supply documentation. An integrated logistics data system, presently in the planning stages, will make available a nationwide automated data processing network accessible through a database management system. The fleet nontactical data system will provide the necessary automated interface, thereby giving the service's maintenance and logistics functions a total automated capability which will support all future Navy serial number tracking systems.

As a follow-on to aircraft engine serial number tracking efforts, the Navy is also expanding its engine component tracking programs. Developed at the Naval Air Rework Facility in Norfolk, Virginia, the program allows maintenance personnel to keep tabs on serially numbered components and assemblies installed on engines. Its database, structured for three-tiered hierarchical relationship tracking, accommodates serialized identification of components and subassemblies and thus assures continuity when examining the relationship between components and their impact on the life of selected end items.

Efforts such as these signal a new era for serial number tracking. Though long recognized as a powerful maintenance tool, the process has had limited usefulness due to various technological and financial drawbacks. With the advent of low-risk, high-speed, and relatively low-cost information technology, the services have been able to solve many of these problems. The four programs discussed earlier demonstrate the progress made in achieving data accuracy and timeliness and illustrate the substantial payoffs serial number tracking is likely to provide in the future. **DMJ**

ROLAND E. BERG is the director of maintenance policy in the office of the assistant secretary of defense (acquisition and logistics). He administers a \$13 billion dollar annual depot maintenance program and is responsible for developing all levels of maintenance policy in the services. Mr. Berg also chairs DoD's joint-service serial number tracking committee. Previously, he was the principal assistant director for supply and maintenance management on the Army staff, and from 1977 to 1980, he served as chief of the property sales assistance division in the Small Business Administration. Mr. Berg holds a bachelor's degree in business administration and a master's degree in public administration from the University of



The promise and peril of overseas maintenance

By LIEUTENANT COLONEL JUSTIN M. MARTIN, USMC

Should DoD do more or less depot-level repair work overseas? Officials must resolve several key issues before they can answer that question.

When defense logisticians discuss readiness, the subject of cost effectiveness is rarely absent from the conversation for long. And in any such exchange, the pros and cons of overseas depot maintenance are likely to provoke lively debate. Simply put, do overseas repair programs enhance or detract from readiness? The verdict is not in yet, and in the meantime, both sides make a case that deserves to be heard.

Proponents of overseas depot maintenance contend that theater repair enhances equipment readiness because it reduces stateside work backlogs and the time required to return hardware to ready status. Opponents counter that it takes work out of the United States, thereby weakening the nation's economy, and erodes the domestic repair base. Both groups acknowledge that any significant reduction in domestic maintenance capability could impair our ability to mobilize.

The United States has overseas depots in every theater in which it has forces and materiel. Despite the skepticism expressed by opponents of the concept, the volume of overseas work continues to grow each year. For example, in fiscal year 1981, the Air Force had only two overseas depot contracts in two countries; cumulative contract value

was \$5.4 million. By fiscal year 1984, the service had 53 contracts in 12 countries, and cumulative contract value surpassed \$174 million. Although these contracts represent only 1.5 percent of the Air Force's depot workload, they cover work done on such strategically vital aircraft as the F-15, F-16, and H-53 helicopter. The rationale given for the appreciable increase is that overseas maintenance reduces repair turnaround time, increases in-theater system availability, and keeps aircraft under theater control.

At the same time that the services are doing more maintenance overseas, U.S. forces are increasingly "fixing forward" beyond our continental limits, as more front-line fighters and combat vehicles move into foreign depots. Currently, each service uses different criteria to determine what work it will perform out-of-country. Although DoD has no official policy concerning the type or amount of work that can be carried out overseas, the director of maintenance policy and representatives of the individual services are now formulating such a policy. Their goal is to allow each service a prudent mix of overseas and stateside maintenance and to give DoD the means to oversee management of the various programs. To date the discussions have addressed key considerations in the areas of readiness, sustainability, cost effectiveness, and reciprocity.

Readiness and sustainability

Most frequently, those who favor overseas depot maintenance argue that it enhances theater readiness and

A Patriot missile in flight at White Sands Missile Range, New Mexico. The Patriot is one multinational defense system which the NATO Maintenance and Supply Agency may help DoD support in the future. Sharing logistics tasks with our allies could help the United States save both money and time in functional

site maintenance significantly reduces repair cycle times for end items and assemblies, and the services can apply the savings in transportation costs to other requirements. To date, however, data that adequately support such claims are lacking.

Overseas depot maintenance may also render U.S. interests vulnerable to sudden increases in the work requirements of the host nation. Would such a situation preempt U.S. work requirements at shared facilities? The recent Falklands incident as well as experience during the 1973 Middle East conflict clearly suggest that our priorities would take a backseat to those of the host nation. Related concerns include possible work stoppages due to foreign labor strikes and the accountability of U.S. property in the hands of foreign contractors.

Opponents of overseas depot repair contend that the vagaries of international laws and uncertainty about the reliability of foreign sources add to the potential for mismanagement. Also disturbing is the prospect of losing foreign repair facilities and the U.S. equipment in them during hostilities. If substantial amounts of such equipment were lost or otherwise unavailable during the early stages of contingency response, readiness and sustainability would obviously suffer.

In a smoothly operating peacetime environment, however, maintenance performed close to the deployment location could enhance near-term theater readiness. Commanders would have fewer end items to evacuate to the continental United States and could therefore keep equipment assets under theater control and stabilize in-theater equipment levels. Operational readiness safety levels could also be lowered, and replacement items stored stateside could be applied to in-theater sustainability requirements.

Cost effectiveness

The constant prospect of military budget cuts and the scrutiny accorded repair and maintenance personnel costs are a fact of life. Consequently, the cost effectiveness of overseas depot maintenance is a key discussion point. Advocates are quick to point out that DoD can stretch a constrained maintenance budget by using repair facilities overseas. The services incur lower intercontinental transportation costs and can pass on costs and concerns associated with personnel management to foreign contractors. The Army now spends approximately \$7,200 to ship a 5-ton truck round-trip from Germany to Anniston Army Depot, Alabama. Transporting that same truck to a German depot costs roughly \$300, a difference of \$6,900. The services could direct aggregate annual savings in transpor-

tion costs for those for work done stateside. The figure shows labor costs for DoD repair work done in the U.S. and in four major host nations. But critics contend that lower foreign labor rates do not always translate into documented cost effectiveness or savings. They point to service-gathered data which indicate that the cost for identical repair work on certain items is higher overseas. Consider, for example, repair costs for an altitude encoder, an airspeed indicator, a transmitter, and a pressure compensator. Overseas, they average \$394, \$481, \$404, and \$729, respectively, whereas in the U.S., the average repair bill for the same items is \$381, \$443, \$335, and \$691.

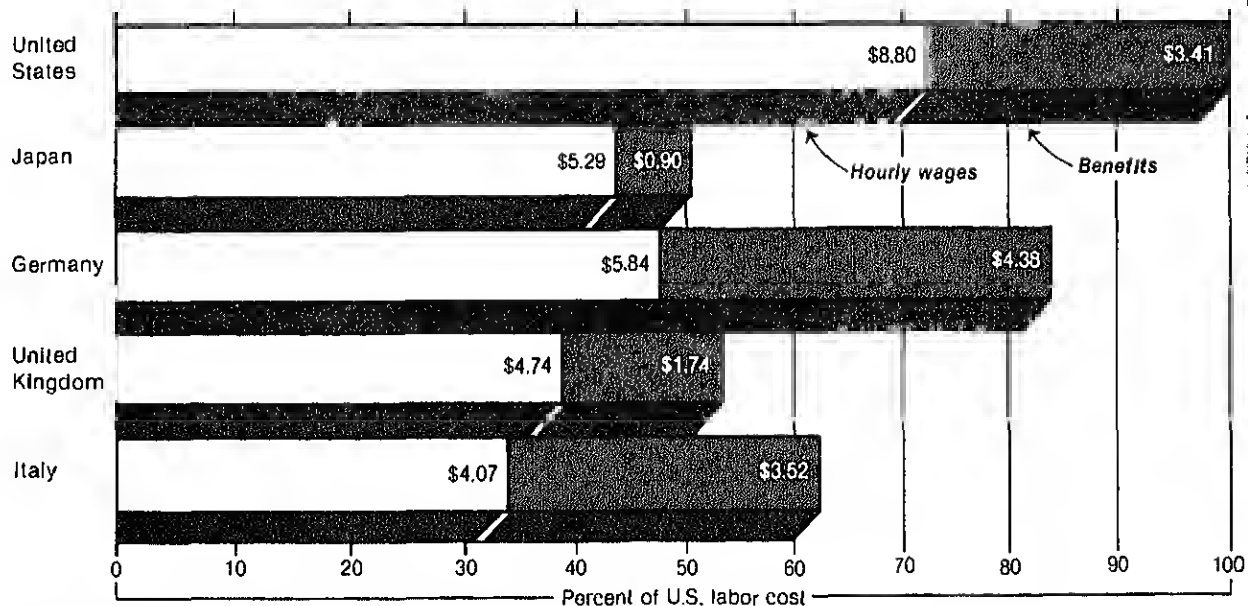
Moreover, claim detractors, further decreases in maintenance performed stateside would lead to fewer domestic repair sources. Eventually, costs for repair work done in the U.S. would escalate, especially in areas such as electronics and electromechanics. And as the amount of available defense-related work declines, so too do incentives for seeking defense contracts. The private sector has repeatedly stated that low-volume work is not economical and that only through high volume can it offer lower-cost rates.

Briefing the Joint Logistics Commanders in 1983, a multiservice task force reported that the domestic electronics industry was losing interest in defense work because the small volume made it unattractive. Presently, DoD contracts account for only about 5 percent of the electronics-support market, yet average redesign costs to support such equipment are high, ranging from \$100,000 to \$200,000 per component. Because the U.S. electronics industry is increasingly reluctant to take on defense work, DoD and service officials are questioning the wisdom of forsaking U.S. contractors for foreign ones.

The long-term health of the domestic repair base is thus clearly an issue. Greater reliance on foreign sources raises doubts about the nation's ability to maintain full industrial capability. It also calls into question our ability to retain the industrial strength necessary to meet DoD requirements in the event of adverse changes in political climates abroad.

Of a more purely domestic nature are concerns about the ongoing decline in the number of Americans employed in the manufacturing field. Because of the close tie between manufacturing firms and repair sources, the trend could have an impact on the availability of industrial-level repair and repair-parts sources. The Bureau of Labor Statistics puts the unemployment rate in the primary and fabricated metal industries at 12 and 9.2 percent, respectively. Both figures are already well above the national unemployment average of 7.5 percent, and if more production and repair

because of lower labor rates and a strong U.S. dollar overseas



Source: U.S. Department of Labor, Bureau of Labor Statistics, 1983

full operating potential would entail additional outlays.

Trade considerations

In the opinion of some observers, defense trade between the U.S. and its allies is out of balance. Though supposedly a "two-way street," the flow more often favors this side of the Atlantic, they contend. If their assessment is true, then increased overseas depot maintenance is one way to help restore equilibrium. And it is an especially attractive option because foreign hardware often fails to meet our diverse defense needs. Moreover, given the scrutiny accorded operation and maintenance budgets, lower foreign labor rates are more appealing still.

In its 1984 study, "The Reconnaissance of Overseas Depot-Level Maintenance," the Logistics Management Institute estimated the contractual value of the overseas depot repair programs at more than \$660 million, of which about \$400 million went to Europe. Although that figure represents only 5.5 percent of DoD's annual expenditure for depot repair, the money spent contributes significantly to host-nation economies.

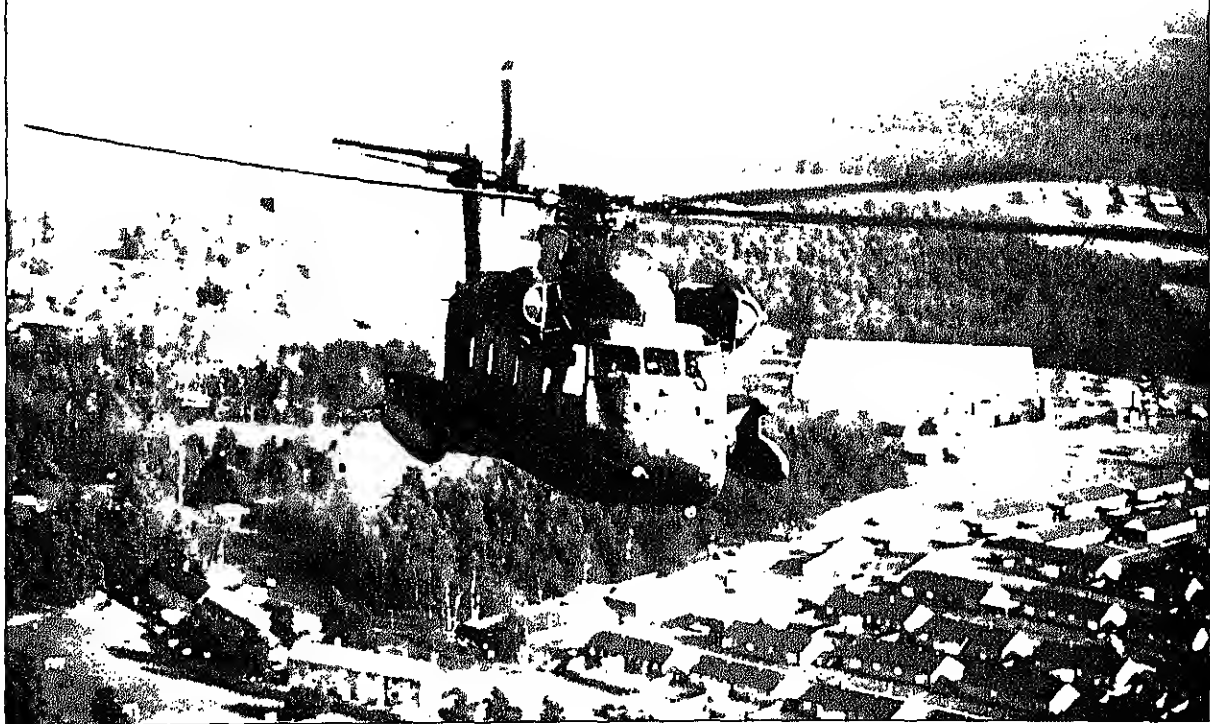
The economic benefit to our allies becomes even more apparent when one considers the associated aspects of overseas maintenance. U.S. maintenance dollars enable foreign contractors to more readily expand existing re air

foster a foreign constituency that is more closely linked to U.S. interests and reassure host-nation governments of this nation's intention to honor its overseas commitments. If our \$660 million investment increased to \$1 billion by 1989, as the above study forecasts, foreign industrial ties to the dollar will become even stronger.

Technology transfer

The United States judiciously guards the transfer of high-technology defense data. In major arms dealings, DoD often withholds technology critical to a system's full operating capability. By doing so, the department ensures that the U.S. will maintain its advantage should the purchasing country resell the system to a non-allied nation. The U.S. does, however, offer purchasing countries financial offsets such as reciprocal maintenance contracts and coproduction agreements, which reduce the overall cost a foreign customer incurs. Some technical experts argue that more technology transfer between the U.S. and its allies is needed if NATO is to maintain its edge in conventional weapons development. They contend that continuous advances in conventional weapon technology are necessary to lessen the alliance's heavy dependence on defensive nuclear weapons.

In the absence of outright technology transfer, depot re-



Though overseas depot maintenance accounts for only a fraction of the Air Force's total depot workload, it covers such critical aircraft as the H-53 helicopter, shown here, as well as the F-15 and F-16. The cumulative value of the service's overseas depot contracts soared from \$5.4 million in 1981 to \$174 million in 1984.

ing, a form of passive technology transfer. In FY 1983, the U.S. Army Depot in Mainz, Germany, awarded six educational contracts to German, Belgian, and British firms. These agreements are intended to foster new sources of overseas depot-level maintenance by giving subcontractors the technical skills needed to perform U.S. maintenance. As the number of overseas depot sources increases, so too does the likelihood that more talent and energies will be devoted to repairing and revitalizing the allied defense inventory. Not only will the technical skill base for repairing U.S. equipment broaden, but so will the production base, because nearly all overseas facilities are

Furthermore, overseas firms are likely to invest a portion of profits realized from U.S. contracts in technical laboratories and research and development programs that may well help reduce the alliance's current dependence on nuclear weapons. At a minimum, increased overseas depot maintenance offers an opportunity for benign technology transfer and nurtures a diverse, competitive industrial base abroad. For reasons of national security, some will continue to argue for caution in transferring U.S. technology beyond our shores. But legitimate, healthy forms of transfer will continue as well, and a broad and productive overseas industrial base can stimulate technology development that will benefit all members of the alliance.

Mobilization enhancement

Proponents argue that in addition to improving readiness and sustainability, overseas depot maintenance will enhance our ability to mobilize. They note that the number of overseas depot facilities will grow proportionately

handed in-theater industrial base provides back-up facilities to offset losses during hostilities. Another benefit is that overseas augmentation of domestic maintenance and production could allow the U.S. to meet force-expansion requirements by increasing output. But the nation could do so only if it did not allow its own industrial potential to shrink in the meantime.

An expanded overseas industrial base, supporters claim, would also free strategic lift, already critically short, needed to move equipment from the states to theater during mobilization. Overseas depots in effect contribute to force multiplication by allowing the service to redirect transportation normally dedicated to returning repaired hardware to the theater. With that transport, they can move additional sustainability resources and thus will be better able to fight a war. Of course, an active, broader repair base overseas would also reduce the distance between repair source and user as well as U.S. dependence on long, tenuous intercontinental supply lines. Reduced equipment loss and a back-up capability in the event of facility attrition stateside would be other benefits during hostilities.

In a conventional war, all of these factors could help tip the mobilization equation in our favor.

Maintenance and support in NATO

The U.S. and its allies established the NATO Maintenance and Supply Agency to provide spare parts and logistics support, including depot-level maintenance, for jointly used weapon systems. Although the office of the secretary of defense and the U.S. European Command support the agency, they have used it sparingly. However, recent indications are that DoD will participate more fully with the agency in supporting such systems as the Patriot missile and the AIM-9L, an air intercept missile. The benefits will be significant because the agency can match U.S. maintenance requirements to European repair sources and can forge the linkage needed for an interoperative European maintenance network.

In addition, the NATO Maintenance and Supply Agency is able to catalog the items in European depots, map the facilities, and align them with weapon systems requirements. Therefore, it could well become the theater's primary repository for logistics data and thus perform an invaluable service in identifying alternative repair sources during a contingency. Also important is the agency's potential for developing depot interservicing capabilities throughout the alliance.

Initiatives in these areas could lead to substantial sav-

ing, and other functional areas. The U.S. now absorbs all those costs for some systems, such as the Hawk missile. The typical turnaround time for missile repairs done by the NATO Maintenance and Supply Agency is 30 days; for missiles evacuated to the states, it is 180 days. Clearly, the agency offers enormous strategic and economic opportunities that the U.S. is just beginning to pursue.

Our military capability in the decades ahead will depend largely on the state of readiness we can attain and maintain. Depot maintenance contributes to that readiness by ensuring that critical weapon systems, support equipment, and personnel are responsive to the demands placed on them. The price tag on DoD's overall depot maintenance program exceeds \$12 billion and is projected to grow to more than \$20 billion by 1990. With the maintenance budget at its highest level ever, the department must continue to use these dollars in an efficient, creditable manner. If overseas depot work does indeed yield the dividends promised, DoD should exploit the concept to the maximum extent.

To date, however, data regarding the effectiveness and efficiency of overseas maintenance are not sufficient to validate the assertions made either for or against the concept. The debate will continue until we have answers to the following questions:

- Are overseas labor costs truly competitive with those in the U.S., and if so, in what areas?
- Are overseas repair turnaround times better than domestic ones?
- To what degree is the readiness of a class of weapon systems enhanced by overseas repair?
- What is the current and potential effectiveness of the NATO Maintenance and Supply Agency?
- What effect will increased overseas dependence have on the U.S. industrial base and mobilization capability?

Answering these questions will not be easy but is a necessary prelude to resolving the issues and determining the extent to which we can rely on overseas depot maintenance. **DMJ**

LIEUTENANT COLONEL JUSTIN M. MARTIN, USMC, is assigned to the installations and logistics department, headquarters, U.S. Marine Corps. He is currently serving as a maintenance management intern in the directorate for maintenance policy, office of the assistant secretary of defense (manpower, installations and logistics). Lt. Col. Martin holds a bachelor's degree in history and government from the U.S. Naval Academy.

Sexual harassment in the workplace

By STEPHEN A. KLATSKY

Mr. Klatsky is the senior civilian personnel labor law counselor at the Army Materiel Command, Alexandria, Virginia. He recently received the command's Preventive Law Award.

A male supervisor has passed notes containing terms of endearment to a female subordinate, unsuccessfully asked her out several times, and called her at home on weekends. During this same period, he has approved the woman's requests for training, given her an outstanding performance appraisal, and promoted her.

Does the employee have legal grounds for challenging her supervisor's advances? Is the supervisor liable for his actions? Is the employer responsible for the behavior of the supervisor?

Before 1980, an employee who was the object of sexual advances could win an action only by showing that refusal resulted in the denial or withdrawal of tangible job benefits. However, the law has evolved over the last five years, and a complainant now has other grounds for obtaining redress. The broadened legal scope derives from Equal Employment Opportunity Commission guidelines which identify types of behavior that constitute sexual harassment. Specifically, the 1980 guidelines cite "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature."

Obviously, such conduct is grounds for action when assent is a term or condition of employment or when acceptance or rejection is the deciding factor in a personnel management decision such as a promotion or job-related award. However, the guidelines

ment when it creates "an intimidating, hostile, or offensive working environment." This criterion gives the guidelines their revolutionary impact.

Shortly after the commission established these criteria, a female employee of the District of Columbia sued her male supervisor who had requested sexual favors from her on several occasions. The lower federal court ruled in favor of the supervisor, contending that the woman had no "cause of action" because she had not been denied job benefits. The complainant then took the case to the Court of Appeals, which overturned the lower court's ruling. Basing its decision on the commission's guidelines, the appeals court ruled that a sexually harassed employee is entitled to redress even if rejection of the advances does not lead to on-the-job reprisal or discrimination. Given this rationale, the

including touching, of two female subordinates. The supervisor appealed the decision to the Merit Systems Protection Board, which upheld the removal, stating, "By sexually harassing his subordinate employees repeatedly, appellant violated the trust the agency placed in him as a supervisor to treat his subordinates with respect and ensure that the workplace is free of sexual harassment." The U.S. Court of Appeals sustained the board's ruling; it found that such supervisory abuse satisfied the Civil Service Reform Act's criterion that removal will be for such cause as will promote the efficiency of the federal service.

A 1983 case further expanded the law by establishing that the supervisor, as well as the agency, has an "affirmative duty" to create and maintain a work environment that is free of sexual harassment. A female employee of the Federal Aviation Administration had been the target of repeated sexual insults, slurs, and innuendos from nonsupervisory male co-workers. After calling the matter to the attention of her supervisors, who were indifferent to her pleas to halt the behavior, the woman brought suit against the agency for the inaction of its supervisors. Ruling for the woman in a decision consistent with the commission's

Basing its decision on EEOC guidelines, the appeals court ruled that a sexually harassed employee is entitled to redress even if rejection of the advances does not lead to on-the-job reprisal or discrimination.

subordinate referred to in the opening paragraph, though not denied job benefits, could probably bring a successful action.

A year later, the courts extended the principle established in the District of Columbia case to federal personnel law. The litigation involved a U.S.

guidelines, the U.S. Court of Appeals stated that management must take appropriate corrective action as soon as it becomes aware of acts of sexual harassment in the workplace. In this case, ample evidence indicated that management knew of such acts in the air-traffic station.

a supervisor becomes aware of sexual harassment at a worksite, he or she should immediately consult the civilian personnel office and the legal office to determine appropriate corrective action. Disciplining the offender is one option. Transferring one of the parties to a different work area is another, and management should not consider a transfer only for the employee. Sometimes assigning the supervisor to a different office is the more equitable solution. Why penalize the subordinate who, except for the objectionable incidents, likes the job, the work conditions, and the co-workers?

Management's affirmative duty includes responsibility for making personnel more aware of the kinds of behavior that are sexually offensive and adversely affect the work unit. Sensitivity training should be mandatory in all equal employment, supervisory, and new employee instruction. Videotapes are now widely available to help managers educate their workers.

Employers also need to create an atmosphere conducive to reporting incidents of sexual harassment. Results of a 1981 Merit Systems Protection Board survey indicated that only 3 percent of all such incidents among executive department personnel were reported to management. As reasons for not notifying supervisors about incidents, workers often cited fear of reprisal or of being labeled a "problem employee." By responding quickly to complaints of harassment, management can do much to alleviate these concerns.

Recently, a number of rulings have further defined behavior that constitutes sexual harassment. In an action brought against a Navy supervisor who made comments and sexual jokes about the type of woman who would work in the installation's machine shop, the Merit Systems Protection Board upheld the agency-imposed discipline against the supervisor. At a

male worker overheard the offensive statements, which were made to a male colleague but not in the machine shop itself. The board's ruling indicates that oral comments, even when not voiced in the actual work area or specifically directed to the complainant, can constitute harassment.

An Army case established the principle that sexual harassment can occur between peers. In other words, it is not contingent upon a supervisor-subordinate relationship. The board upheld the downgrade given to a male employee for shedding his clothes and

first, the complainant later submitted for fear of losing her job. Not only did the court rule that the woman retained her right to sue, but it also stated that the employer could be held liable for the supervisor's actions even though management was unaware of the situation.

To date, no suits involving federal employees have addressed the principles established in this case. However, the appeals court that rendered the decision is very influential in litigation involving sexual harassment. Thus, federal civil law may well follow the same

Equal Employment Opportunity Commission guidelines and recent case law suggest that words and actions once dismissed as merely flippant or cheeky are no longer tolerable in the workplace. They are sexually offensive and constitute harassment.

skinny-dipping in front of a female colleague. The two had been on a work assignment requiring them to navigate an installation's isolated waterways.

Reviewing another Army case, the board ruled that incidents occurring off-duty, but during a temporary-duty assignment, can be construed as sexual harassment. In this instance, the board upheld the agency's disciplinary action against a male supervisor who had asked a female subordinate to conduct a pre-brief in his motel room at night. Board members found that the supervisor's conduct clearly violated the supervisor-employee relationship and adversely affected the efficiency of the service. They therefore concurred with the agency's decision to downgrade the individual and strip him of his supervisory duties.

In a private-sector case decided earlier this year, the Court of Appeals for the District of Columbia determined that capitulation to sexual advances does not prevent an employee from obtaining redress. Despite having rejected her supervisor's advances at

line of reasoning.

In determining whether behavior constitutes harassment, an adjudicatory body will look at the totality of the circumstances, including the nature of the advances and the context in which they were made. For example, a federal arbitrator did not find harassment in a case in which a supervisor had asked a subordinate for a date three times over a two-month period. In rendering his decision, the official cited the "gentlemanly" manner in which the supervisor had approached the complainant in each instance.

Equal Employment Opportunity Commission guidelines and recent case law suggest that words and actions once dismissed as merely flippant or cheeky are no longer tolerable in the workplace. They are sexually offensive and constitute harassment. All federal employees, regardless of rank, age, sex, or career field, need to be aware that co-workers have a right to fair treatment and a work environment that allows them to perform at full capacity.

report synopsis

Toward a more effective defense: the final report of the Defense Organization Project

The Center for Strategic and International Studies, Georgetown University, Washington, DC, February 1985.

In 1983, The Center for Strategic and International Studies initiated the Defense Organization Project, under which nearly 70 distinguished researchers and analysts examined ways to improve the organization and management of the U.S. defense establishment. The study team concluded that selected facets of military planning, resource allocation, and program management are ripe for reform.

Military planning. Advice that does not reflect parochial service interests is essential if civilian defense officials are to formulate effective and appropriate strategy. To ensure relevant and unbiased advice, Congress should amend the National Security Act so that the chairman of the Joint Chiefs of Staff is the principal military adviser to the president, secretary of defense, and National Security Council. Currently, the joint chiefs corporately serve in that capacity, and they sometimes fail to provide candid advice on issues affecting an individual service's prerogatives.

With assistance from the joint chiefs, the chairman should prepare force planning recommendations that accurately reflect policy and fiscal guidance from the secretary of defense. Service chiefs should continue to advise the chairman and the service secretaries on all issues and the president, secretary of defense, and National Security Council on critical issues.

The Defense Department should expand the role and authority of the under secretary of defense for policy to ensure that programming and budgeting decisions are consistent with defense priorities and policies. The under secretary for policy should continue to draft the Defense Guidance, but he should also become more involved in the program and budget review phases of the force development process. The under secretary's office should comprise three assistant secretaries, one for each of DoD's major strategic missions—nuclear deterrence, North Atlantic and European defense, and regional defense.

Resource allocation and congressional oversight. Congressional procedures for reviewing the defense budget perpetuate many of the problems associated with defense policy-making and management. By using much of its time

allocating defense resources toward those priorities. Modifying the congressional budget review process would improve legislative oversight and promote procedural reforms in policy-making.

Three main problems hinder Congress's oversight role. First, members of Congress have so many demands on their time that they cannot adequately analyze today's complex issues. There are too many issues to debate and too little time to review each thoroughly. Second, each chamber reviews the defense budget at least three times a year, with a different committee controlling each review. This redundancy adds to the natural reluctance to make timely, binding decisions. And third, although it insists that DoD develop long-term plans, Congress closely reviews only the plan for the forthcoming year.

To help streamline the congressional review process and refocus legislative attention on important strategic and resource-allocation issues, the study team recommends a two-year defense budgeting cycle and a clearer division of labor between defense-authorizing and defense-appropriating committees. Under biennial budgeting, Congress would debate, amend, and approve a two-year authorization and appropriation in the first year of each

By using much of its time to review virtually every line item in the budget, Congress foregoes the opportunity to perform more fundamental tasks, namely, establishing national strategic priorities and allocating defense resources toward those priorities.

congressional term. In the second year, committees would review and evaluate existing programs. Consolidating the current authorizing and appropriating authorities into a single defense program committee would substantially improve the efficiency and effectiveness of congressional defense oversight.

The unified and specified commanders should play a more significant role in the resource-allocation process and exercise greater authority over their component commanders. Toward this end, they should have operational and budgetary control of their forces. Also, the office of the secretary of defense needs to improve its ability to oversee and integrate programs related to force readiness and sustainability; DoD should establish a third under secretary of defense to oversee these programs.

Planning and programming. The planning,

o expectations as a device for multiyear man-
ning. All three phases need revision.
asures would make the planning phase more
s noted earlier, the responsibilities of the un-
of defense for policy should be expanded to
rogram and resource decisions reflect mission-
ring. Also, the chairman of the Joint Chiefs of
istance from the joint staff, should prepare
g recommendations that reflect realistic esti-
mable resources.

able for a three-phase approach is that the
process should translate security plans and
specific budget requests. In practice, though,
and budgeting have evolved into competing,
complementary, processes. The programming
originally to have been the juncture at which
n-makers evaluated alternative programs and
ve-year defense plan. The subsequent budg-
was to have been a straightforward process of
e first year of the approved program. Instead,
g phase has become a separate decision-
ss, a time when officials reconsider many of
made during the programming phase.
on issues that have received the attention of
of defense during the programming phase
e the budget review. Decisions on less visible
ver, are often overturned or significantly al-
get time, even when the circumstances sup-
iginal decision remain unchanged. This pattern
program decisions undermines the program-
s and the planning efforts of many senior

y team recommends a merger of the
and budgeting phases of the system into a

*Integrating the current authorizing and
budgeting authorities into a single defense
committee would substantially im-
prove efficiency and effectiveness of con-
gressional defense oversight.*

m- and mission-oriented process that is re-
levant budget inputs. Under such an arrange-
programming and budgeting functions would be
when the secretary of defense issues policy and
be, when the services and operational com-
re program and budget requests, and when
f the secretary of defense reviews those

vices' acquisition strategies by developing an integrated,
long-range investment plan that allocates broad categories
of resources to mission areas. Because major system de-
velopment takes 8 to 12 years, the department should base
its plan on a 15-year assessment of the military threat. The
under secretary of defense for policy and the director of pro-
gram analysis and evaluation would be responsible for
preparing the plan for review by the secretary of defense.

*The rationale for a three-phase approach is
that the programming process should trans-
late security plans and priorities into specific
budget requests. In practice, though, pro-
gramming and budgeting have evolved into
competing, rather than complementary,
processes.*

Officials would update the plan annually to adjust for
changes in technology, threat, and fiscal realities. In addi-
tion to ensuring the integration of the services' long-range
acquisition efforts, such an investment approach would help
managers forecast resource demands over a 15-year per-
iod.

The study team also recommends that DoD require the
military services to establish internal contracts that set cost,
performance, and schedule baselines for their weapon pro-
grams. To ensure the necessary level of stability, the ser-
vices would have to refrain from adjusting program charac-
teristics and specifications. Only the service secretary
should be permitted to change such contracts.

If the Defense Department is to reduce acquisition costs,
it must expand its use of market incentives, according to the
report. The department should promote contractor competi-
tion throughout the life of a weapon system, allow contrac-
tors to increase profit margins when costs fall, encourage
the services to divert cost savings toward increased pur-
chase quantities and improved performance, and enhance
career opportunities for acquisition managers. Also, DoD
should establish unit cost as a primary criterion and require
contractors to meet that requirement just as they are re-
quired to meet performance specifications.

The chance for significant defense reform may be greater
now than at any time since 1958, when President Dwight D.
Eisenhower directed a sweeping reorganization of the de-
partment. Legislation toward this end will probably be intro-
duced during the 99th Congress. Certainly, any forthcoming
reforms must provide a functional and organizational frame-
work that effectively integrates diverse management per-
spectives and uses constrained defense resources
efficiently.

New program to honor top maintenance units

A recently established Secretary of Defense Maintenance Awards Program will recognize military units that have attained an outstanding level of achievement in weapon system and equipment support.

Intended as an incentive for military maintenance specialists, the program will honor units in each of three categories of authorized manpower strength: 25 to 300, 301 to 999, and 1,000 or more personnel. Awards will be presented annually to winners and runners-up in each category, and one of the three winners will receive the Phoenix Award for best maintenance element in DoD. The phoenix, a mythological bird that lived for some 500 years before being consumed by fire and then rising out of its own ashes, is a fitting symbol of maintenance excellence. For just as the phoenix gave itself new life, so too does maintenance give continued life to military hardware.

Active-duty and reserve-component units performing other than depot-level maintenance are eligible for the award. Nominations should be submitted through the appropriate service department to the office of the secretary of defense. The awards are sponsored by the American Defense Preparedness Association. (OASD(MI&L) Maintenance Policy Directorate Announcement: March 1985)

Navy offers new bonus to curb pilot losses

In a move designed to stem an exodus of pilots, the Navy is offering lump-sum cash bonuses to critically skilled pilots who agree to remain in the

service for four to six additional years. Approved last February, the bonuses, ranging from \$24,000 to \$36,000, are expected to be more attractive than current reenlistment incentives that offer installment payments.

The Navy is losing about 175 pilots per month, a rate three times higher than in FY 1984. This trend, which is resulting in a significant shortfall of second-term aviators, is attributed to the commercial sector's increased demand for pilots. (Defense Week: February 19, 1985)

DoD seeks to increase lure of survivor plan

Defense officials are conducting a comprehensive review of the Survivor Benefit Plan to identify ways to make it

more attractive to retiring servicemembers.

For FY 1985, the department estimates that overall participation in the plan will be 55 percent, with 45 percent of retiring enlisted personnel and 74 percent of retiring officers enrolling in the program. Dr. Lawrence J. Korb, Assistant Secretary of Defense (Manpower, Installations and Logistics), hopes that revisions to the plan will boost overall participation to 75 percent.

Specifically, officials are evaluating recommendations made during the Fifth Quadrennial Review of Military Compensation. Changes proposed are intended to improve the cost formula for retired pay and stabilize the impact of Social Security offsets. The study team will also examine the plan's government subsidy rates and

the methods by which participants can terminate enrollment.

DoD is working with the congressional armed services committees to design legislation that will make the plan more attractive. (OASD (PA) news release: January 18, 1985)

[Editor's note: For more information about the Survivor Benefit Plan, see the Fourth Quarter 1981 and Fourth Quarter 1984 issues of the *Defense Management Journal*.]

Air Force lets radar technology contract

Westinghouse Electric Corporation has received a \$28.6 million contract to develop Ultra Reliable Radar technology that will benefit future and some current Air Force weapon systems. Awarded by the Air Force Aeronautical Systems Division, the development contract runs through January 1990.

Radars incorporating the new technology are expected to have a mean time between failure roughly 10 times greater than today's radars, which require maintenance after about every 45 hours of operation. Featuring very high speed integrated circuitry, the advanced radars will be able to process information 50 to 100 times faster than older systems. Moreover, they will be 10 times smaller, lighter, and more economical than their predecessors.

The new technology will be suitable for upgrades of such aircraft as the B-1B, F-15, F-16, and the Advanced Tactical Fighter. The Air Force will begin testing the Ultra Reliable Radar technology in April 1988 at the Westinghouse facility in Baltimore. (USAF Aeronautical Systems Division news release: February 15, 1985)



Aided by the Visually Coupled Airborne Systems Simulator, pilots in the future will be able to see a panoramic view at optical infinity by focusing on a video screen that is part of the flight helmet. Designed for use in supersonic flight and simulation training, the innovative system will instantaneously superimpose pertinent flight data on the projected image. (U.S. AIR FORCE PHOTO)

Sixth International Logistics Symposium

May 14-16 Luxembourg

CONTACT: (202) 393-3620

National Security Industrial Association, Dept. IL, Suite 901,
1015 15th Street, N.W., Washington, DC 20005

Fourth Annual ICAF Mobilization Conference

May 16-17 Washington, DC

CONTACT: (202) 475-1887 or AUTOVON 335-1887

Mobilization Conference Committee, Industrial College of
the Armed Forces, Fort McNair, Washington, DC
20319-6000

1985 SAE Government/Industry Meeting and Exhibit

May 20-24 Washington, DC

CONTACT: (412) 776-4841

Society of Aerospace Engineers, 400 Commonwealth
Drive, Warrendale, PA 15096

Foreign Military Sales

May 23-24 Washington, DC

Achieving Superiority Through Innovative Logistics

June 3-4 Washington, DC

CONTACT: (213) 534-3922

Technical Marketing Society of America, P.O. Box 3608,
Torrence, CA 90510-3608

Advanced Management Skills and Techniques

May 29-31 New York, NY

June 24-27 Washington, DC

Improving Your Managerial Effectiveness

June 3-6 New York, NY

June 24-27 Boston, MA

Executive Effectiveness

July 15-19 Williamsburg, VA

CONTACT: (518) 891-0065

American Management Association, P.O. Box 319,
Saranac Lake, NY 12983-9988

39th Armed Forces Communications and Electronics Convention and Exposition

June 4-6 Washington, DC

CONTACT: (703) 425-8525

Armed Forces Communications and Electronics
Association Programs Office, 5641 Burke Center Parkway,
Burke, VA 22015

66th International Conference on Excellence in Management

June 16-19 Philadelphia, PA

CONTACT: 215 659-4300

Administrative Management Society Conference

Department, 2360 Maryland Road, Willow Grove, PA
19090

Data Administration: Development and Practice

June 20-21 Avon, CO

CONTACT: (301) 762-1288

Barnett Data Systems, 19 Orchard Way North, Rockville,
MD 20854

Strategic Defense Initiative Conference

June 25-26 Laurel, MD

Productivity and Quality Symposium

Aug 27-28 Houston, TX

CONTACT: (703) 522-1820

American Defense Preparedness Association, Rosslyn
Center, Suite 900, 1700 N. Moore Street, Arlington, VA
22209

Accounting Procedures in Federal Agencies

June 25-27 Washington, DC

Budget Presentation and Justification

July 15-19 Washington, DC

Cost Accounting for Government Contracts

Aug 7-9 Washington, DC

CONTACT: (202) 632-5600

U.S. Office of Personnel Management, Financial
Management Training Institute, P.O. Box 7230,
Washington, DC 20044

20th Annual International Logistics Symposium

Aug 20-22 San Diego, CA

CONTACT: (619) 271-6602

Society of Logistics Engineers, P.O. Box 26940,
San Diego, CA 92126

Manufacturing Cost Reduction

Sept. 10-11 Raleigh, NC

Production Planning and Control/Inventory Management

Oct 8-9 Raleigh, NC

CONTACT: (919) 737-2261

North Carolina State University, Jane S. McKimmon Center,
Raleigh, NC 27695-7401

APICS 1985 Fall Seminar

Sept. 18-20 Las Vegas, NV

CONTACT: (703) 237-8344

The American Production and Inventory Control Society
Seminar Committee, 500 West Annandale Road, Falls
Church, VA 22046-4274